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SOIL RESOURCES OF SYNCRUDE LEASE 22

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Pedocan Land Evaluation Ltd.

FOREWORD

Syncrude Canada Ltd. continues to conduct environmental research in the Athabasca Tar sands region. The following report describes the soil resources of Syncrude Lease 22. The report is the second to be published in Syncrude under the broad heading of soil resources. The previous report, numbered 1978-1 in Syncrude's Environmental Research Monograph series, describes the soil resources of Syncrude Lease 17.

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SOIL RESOURCES

OF

SYNCRUDE LEASE 22

Prepared for
SYNCRUDE CANADA LTD.

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1.0 EXECUTIVE SUMMARY

This inventory of the soils of Syncrude Lease 22 has been prepared as part of an environmental baseline data collection program conducted by Syncrude Canada Ltd. The soil inventory is presented in report and map form. Intensive sampling and mapping was conducted during the summer of 1984, which was supplemented by analysis of key soil properties in the laboratory. The following points summarize the distribution and characteristics of the soils on Lease 22:

1. Poorly drained mineral soils and peat wetlands constitute slightly more than half (54 percent) of the lease area. The poorly drained mineral soils occupy 25 percent of the soil landscape and Organic soils, which have greater than 40 cm of peat, occupy 29 percent.

2. Freely drained mineral soils make up only 37 percent of the lease surface. This land area includes well, moderately well, and imperfectly drained soils, developed on glaciolacustrine clays and glaciofluvial sands.

3. River banks, stream channels, and disturbed land constitute nine percent of the land surface.

4. The majority of the mineral soils are fine textured Luvisols and Gleysols. These clayey textured soils occur over approximately 35 percent of the lease. Sandy textured soils, including Brunisols and Gleysols, occupy approximately 10 percent of the lease.

5. The peat deposits are seldom thicker than 2 m and are more commonly less than 1 metre thick. Of the estimated total volume of 66 million cubic metres of peat on the lease, approximately 51 percent occurs as deposits

within the thickness range of 150 to 250 cm. Approximately 32 percent occurs as deposits of 50 to 150 cm thick, and 17 percent is in the 15 to 50 cm range.

6. Permafrost occurs sporadically in peatlands, with its presence usually coinciding with mounded bog peat landforms.

7. The Soil Map, presented in two halves at 1:20,000 scale, identifies the soils by series name and map unit, which have been correlated with the Alberta Soil Names File and with the names established in the reconnaissance soil survey of the area.

8. Soil patterns in the area are generally quite simple, with large homogeneous soil units. The major criteria for differentiating soils are parent material and drainage conditions. Extrapolation of data within and between soil map units can be done with a fairly high degree of confidence due to this homogeneity.

2.0 INTRODUCTION

This soil survey of Syncrude Lease 22 has been prepared for Syncrude Canada Ltd. by Pedocan Land Evaluation Ltd. in report and map form. The surface soil patterns have been mapped at a scale of 1:20,000; and soils have been described in terms of physical and chemical properties and site characteristics; and classified by the Canadian System of Soil Classification. Both mineral and organic (peat) soil resources are characterized and areal distributions are summarized.

Those aspects of the climate, physiography, geology and vegetation of the area that relate to the soil characteristics have been described briefly.

The survey relied on intensive field inspection and sampling and aerial photograph interpretation to produce the inventory. The soils of the northwestern portion of Lease 17 were also mapped and sampled to complete an earlier inventory of the eastern portion of that lease conducted by Twardy (1978).

3.0 DESCRIPTION OF THE STUDY AREA

3.1 Location and Extent

Syncrude Lease 22 is located in northeastern Alberta, approximately 50 km north of Fort McMurray, and immediately north of the current Syncrude development (Figure 1). It covers a total area of approximately 19,600 hectares within Townships 93 and 94, Ranges 10, 11 and 12, west of the fourth meridian. The lease is bounded on the east by the Athabasca River and extends approximately 20 km to the west, including parts of the MacKay and Dover River valleys.

The northwestern portion of Lease 17, approximately 1800 hectares, which lies west of the MacKay River (Figure 1) was also included in the inventory.

The area is accessed by Highway 63 along the eastern edge; and by trails and cutlines which can be travelled only with all-terrain vehicles.

3.2 Physiography and Drainage

Lease 22 is located on a large, nearly level plain, which is characterized by extensive wetlands. Significant relief is provided only by the dissected valleys of the major rivers, which includes the Athabasca and its tributaries, the MacKay and Dover Rivers (Plate 1). The majority of the study area is located on the Dover Plain (after Pettapiece, in prep.); and the area immediately adjacent to the Athabasca River falls on the Embarras Plain (Figure 2).

The Dover Plain is a level to very gently inclined glaciolacustrine plain on the west side of the Athabasca River, north of Fort McMurray. The elevations range from a low of 300 m to a high of 420 m. The underlying bedrock is composed of Lower Cretaceous Clearwater and McMurray Formations and

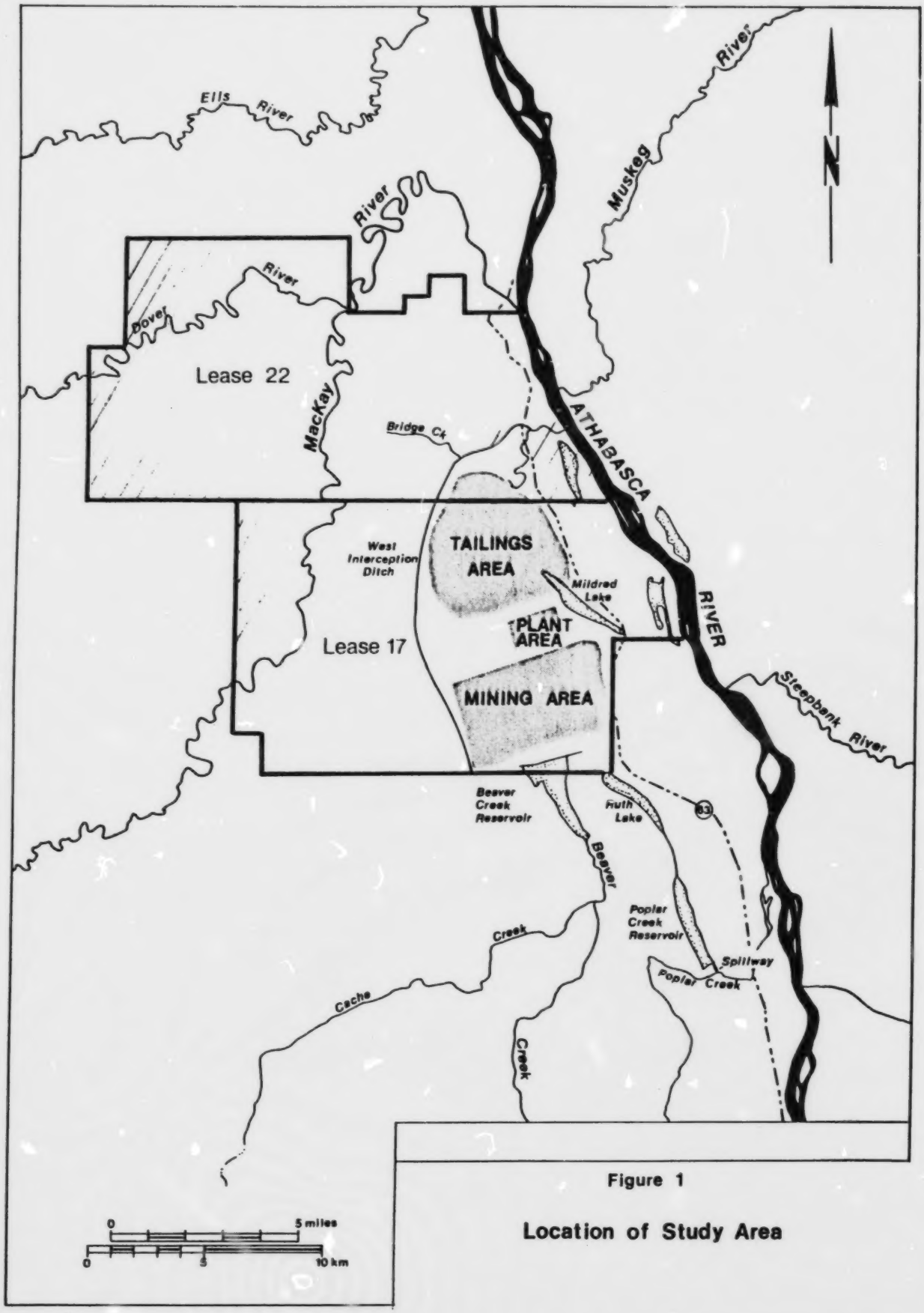
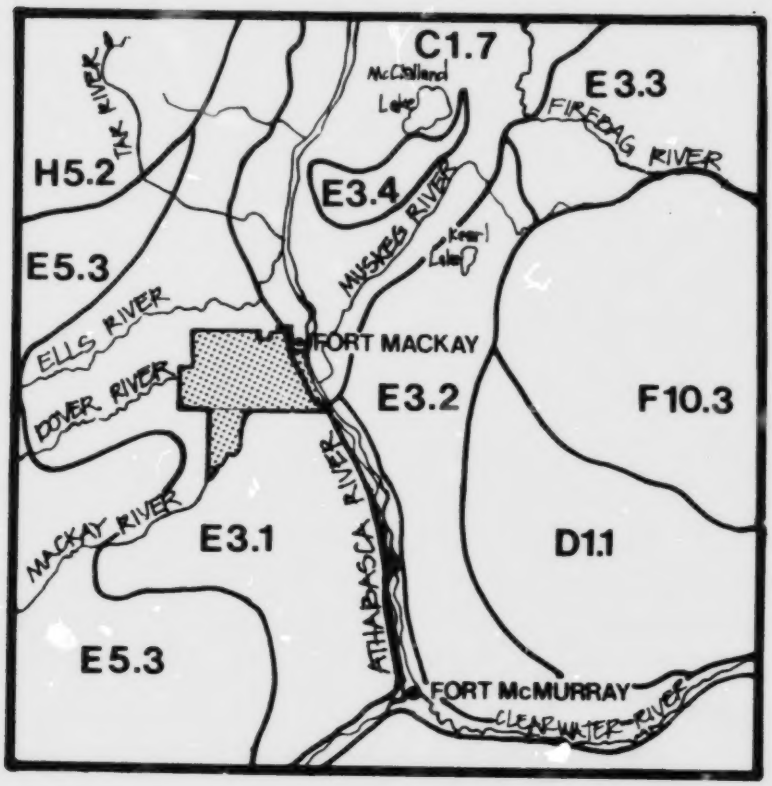


Figure 1

Location of Study Area



REGION		SECTION		DISTRICT	
C	Northern Plains	C1	Great Slave Plain	C1.7	Embarras Plain
D	Saskatchewan Plains	D1	Methy Portage Plain	D1.1	Steepbank Plain
E	Northern Alberta Lowlands	E3	McMurray Lowland	E3.1 E3.2 E3.3 E3.4	Dover plain Kearl Lake Plain Johnson Lake Plain Fort Hills
		E5	Wabasca Lowland	E5.3	McKay Plain
F	Eastern Alberta Plains	F10	Firebag Hills Upland	F10.3	Muskeg Mountain
H	Northern Alberta Uplands	H5	Birch Mountains Upland	H5.2	Birch Mountains

FIGURE 2 : PHYSIOGRAPHIC CLASSIFICATION OF THE GENERAL AREA AFTER PETTAPIECE (in prep.)

the vegetation is characteristic of the Moist Boreal Mixedwood (Strong and Leggat, 1981). Soils are dominantly Gray Luvisols developed on clays and Organics.

The land surface is level to undulating, with very little local relief, resulting in poor drainage and large areas of wetlands. The MacKay and Dover Rivers are incised 15 to 20 m below the surface of the plain, providing some drainage along their margins. Tributary streams of these rivers do not have well defined channels, and are often dammed and diverted by beaver activity.

The Embarras Plain is an undulating glaciofluvial plain with some rolling to ridged eolian and meltwater channel sediments. Elevations range from a low of 200 m at the Athabasca River to a high of 300 m. The slopes are in the range of 2 to 15%. The underlying bedrock is Lower Cretaceous Clearwater and McMurray Formations. Soils are usually sandy Eluviated Dystric Brunisols with approximately 10% Organic soils and the vegetation is categorized as Dry to Moist Boreal Mixedwood (Strong and Leggat, 1981).

3.3 Surficial Geology

The surficial geology of the area has been previously mapped at a reconnaissance scale (1:250,000) by Bayrock and Reimchen (1974) and at a semi-detailed level (1:50,000) by Thompson et al. (1978). The area was last glaciated during the Pleistocene period by the continental ice sheet that advanced southward from the Canadian Shield. During deglaciation, a large ice-marginal lake (Lake McConnell) was formed when the glacier retreated north of Fort McMurray. Lacustrine sediments were deposited over extensive areas. After the ice retreated to about the Fort Hills, the Ancient Athabasca River inundated the portion of the study area corresponding to the Embarras Plain, leaving glaciofluvial meltwater deposits.

Post glacial deposits include recent fluvial sediments and the large areas of peat on poorly drained land. The organic deposit is generally thin, (less than

120 cm) but can be as thick as 300 cm. The peat is composed of either moss, or sedge and moss plant origin, and is generally moderately decomposed. The majority of the peat deposits overlie clayey glaciolacustrine deposits.

3.4 Soils

The soil resources of the general region have been previously described by Alberta Research Council at a reconnaissance scale of 1:126,720 (Turchenek and Lindsay, 1982). That report updated the previous exploratory soil survey at a scale of 1:750,000 (Lindsay et al., 1962) with new soils information. The soil series names established by Turchenek and Lindsay are used in the present inventory and a table correlating the soil units with Lease 22 is provided in Appendix A. Most of Lease 17, which is directly south of Lease 22, was mapped at a detailed scale of 1:24,000 by Twardy (1978). The soil names he used are also correlated in Appendix A.

The soils of the area are typical of the Boreal plains in northeastern Alberta. Gray Luvisols are the common soils on medium to fine textured materials with free drainage. Dystric and Eutric Brunisols have developed on freely drained glaciofluvial sands. Gleysolic soils occupy the poorly drained sites in mineral soil landscapes. Extensive areas are occupied by Organic soils in very poorly drained bog and fen peatlands. Permafrost occurs sporadically in the peat soils (Turchenek and Lindsay, 1982).

3.5 Vegetation

Vegetation of the area is typical of the Boreal Mixedwood Ecoregion as defined by Strong and Leggat (1981), and the Mixedwood Boreal Forest Region of Rowe (1972). Vegetation of the general area has been described by Raup (1946), Stringer (1976) and Krumlik (1981). More detailed inventories and descriptions of vegetation types in the general vicinity of Lease 22 have been compiled by Syncrude Canada Ltd. (1973), Shell Canada Ltd. (1975), Peterson and Levinsohn (1977), the Alsands Project Group (1978), Hardy Associates (1978) Ltd. (1978)

and Knapik and Westworth (1982). A detailed inventory of forest types of Lease 22 has recently been prepared by Reid and Sherstabetoff (1984).

Distribution of vegetation types is controlled by moisture regime, nutrient regime, and fire history. Vegetation associated with hygric Organic soils, which includes black spruce bogs, tamarack-sedge fens, and willow-alder wetlands, dominates the area. Mesic to subhygric aspen forests are the second most abundant forest type, occurring on clayey Luvisolic and Gleysolic soils. Jackpine forests are usually associated with xeric Brunisolic soils on sands, which are most common on the Embarras Plain, adjacent to the Athabasca River. Mature white spruce forests are uncommon due to fire and logging history, but occur on mesic to hygric clayey Luvisolic and Gleysolic soils.

Riparian vegetation occurs along the stream channels of creeks and rivers in the area, associated with a wide range of soil types and moisture regimes.

3.6 Climate

The climate of the general area has been described by Longley and Janz (1978). Long term temperature and precipitation data are available from the AES weather station at Fort McMurray airport (Environment Canada, 1975).

The climate is typically northern continental with short, warm summers and long, cold winters; a summer-high, winter low distribution of precipitation; and frequent summer thunderstorms. July is the warmest month and January is the coldest. The mean daily range varies between 9.3°C in November and 14.6°C in May and June. The average frost free period is 69 days, from approximately June 15 until August 24, with a range of 8 to 115 days. The mean annual precipitation is 471.9 mm with the peak occurring in August and July. Two thirds of the total precipitation occurs during the growing season.

The soil climate of the area is classified as Cryoboreal, cold-subhumid for mineral soils, and Subarctic-peraquic for Organic soils. Poorly drained

mineral soils may remain frozen for part of the growing season, and Organic soils have localized occurrence of permafrost. Freely drained soils are often dry in some part of the soil profile for part of the growing season.

4.0 METHODS

4.1 Soil Survey Methods

The purpose of a soil survey is to identify and delineate soil patterns or soil units in the landscape; to characterize the soil units; and to present the information to the user.

Soil mapping is based on the philosophy of pedology - that soils are natural bodies that reflect the influence of their environment. Point observations of soils can be extrapolated to areas by using principles of geomorphology and geology, especially surficial geology, combined with vegetation pattern indicators. Since soil is a continuum, and adjacent soils seldom have sharp boundaries, soil units are defined as having a certain range of properties. These soil units are delineated on the basis of parent geologic material and landform, soil profile, and soil moisture conditions. The soil and land attributes recognized in mapping are important for various land uses.

The soils have been classified and described according to the criteria established by the Canada Soil Survey Committee (1978). This system classifies soils in their natural state, and thus indicates relationships between soils and their environment. During field investigations, soil properties examined include depth and thickness of horizons, color, texture, structure, consistence, and any other pertinent details. Site characteristics such as geological materials and landform, topography, drainage and surface stoniness were also described using established procedures. The soils have been named and correlated to the Alberta Soil Names File.

Black and white panchromatic aerial photographs, at a scale of 1:20,000, and field observations were used for identifying soil boundaries.

The soil patterns or Map Units are labelled using soil series names and numbers in the numerator and topography class in the denominator. For example, the notation: $\frac{DOV2}{2}$

identifies an area of Dover (Orthic Gray Luvisols on clays) soils (indicated by DOV) with significant gleyed and Gleysolic soils (indicated by the 2) on topography class 2 (0.5 to 2% slopes). The numbers behind the soil series letters in the numerator identifies a soil unit with significant different soils on similar parent material. For example MIL2 indicates an area of dominantly (40% or more) Mildred soils (Eluviated Dystric Brunisols on sands) with significant (15-40%) gleyed or gleysolic soils on sands. Inclusions (<15%) of soils are not identified in the legend but are mentioned in the descriptions.

Map Units of soils developed on variable parent materials were mapped as complexes of soil series and numbers (soil units). For example, the notation: ALG1-KNZ3 identifies an area which contains 40% or more of Algar 1 soil unit (Algar soils with significant Dover soils) and 15-40% of the Kenzie 3 soil unit - a relatively pure unit of Kenzie soil (refer to Soil Map Legends).

The soils were described at 640 sites to a depth of 1.0 m for mineral soils and to the bottom of the peat layer for Organic soils. Typical profiles were sampled at 63 sites for laboratory analysis (Appendix B). The inspection and sample sites are shown on the soil map (back pocket) and a summary of the inspection sites is presented in Appendix C. Soil inspections and sampling were concentrated in areas where development activities are planned. Access to the area was very limited, requiring the use of all-terrain vehicles, helicopter support and walking (Plate 2).

River banks (RB Land Units), stream channels (SC Land Units) and beaver dams (BD Land Units) were not sampled due to extreme variablility in soil development, material types, and moisture regime over short distances; and inclusions of non-soil components. These areas are described as being Miscellaneous Land Units with complex soil patterns.

4.2 Laboratory Analysis

Typical soils of the study area were sampled at 63 sites for laboratory analysis of key soil quality parameters. The analyses were conducted by Norwest Soil Research Ltd. (Edmonton) using methods outlined by McKeague (1978). Bulk densities and pyrophosphate indices were done by Pedocan Land Evaluation Ltd. Table 1 outlines the methods of analysis. The original laboratory data sheets are presented in Appendix D.

Table 1
ANALYTICAL METHODS

Analysis	Procedure	Reference
pH (water)	saturation extract	M* p. 68
Electrical Conductivity	saturation extract	M p. 69
Calcium carbonate	gravimetric loss	M p. 87
Cation Exchange Capacity and Exchangeable Cations	NH4OAC, pH7	M p. 78
Organic C	Leco furnace combustion	M p. 109
Total N	semi-micro Kjeldahl	M p. 122
Particle Size Analysis	hydrometer	M p. 15
Ash	combustion	AOAC** 7.009
% Fiber Unrubbed	----	M p. 56
% Fiber Rubbed	----	M p. 57
Bulk Density	core method	M p. 30
Pyrophosphate Index	field method	----

M* McKeague, J.A. 1978. Manual on Soil Sampling and Methods of Analysis, 2nd ed. Can. Soc. Soil Sci., Ottawa.

AOAC** Association of Analytical Chemistry. 13th ed., 1980. Association of Official Analytic Chemists, Virginia, USA.

5.0 SOILS

5.1 General Soil Patterns

The soils of the study area are typical of the Northeastern Alberta Boreal Forest region (Turchenek and Lindsay, 1982; Twardy 1978; Hardy Associates (1978) Ltd., 1978; Knapik and Westworth, 1982). Luvisolic soils are developed on clays; Brunisolic soils are developed on sands; and there is a high percentage of Organic soils. A key to soil names and correlation to soil taxonomy and parent materials is provided in Table 2.

The majority of the area, corresponding to the Dover Plain physiographic district is a nearly level to undulating glaciolacustrine plain. On moderately well drained, slightly elevated sites Orthic Gray Luvisols (Dover soils) are developed on the clays with occasional Gray Solod soils (Joslyn soil series). Peaty Rego Gleysols (Algar soils) and fairly thin Organic soils (Kenzie and Eaglesham soils) occupy a significant portion of the area on poorly and very poorly drained, depressional to level areas of the plain (Plate 3). The deeper Organic soils have localized occurrence of permafrost (Mikkwa soil series).

The area adjacent to the Athabasca River has undulating to ridged sandy glaciofluvial deposits typical of the Embarras Plain physiographic district. Eluviated Dystric Brunisols (Mildred soils) occupy the well drained slope positions. Gravelly and cobbly lenses and layers occur at depth in some of the soils (Ruth Lake soils) on ridges near the Athabasca River.

Sandy or silty textured peaty Rego Gleysols and Rego Gleysols (Bitumount soils) and fairly thin Organic soils (Kenzie and Eaglesham soils) occupy the poorly drained swales and old channel scars on the fluvial landscape.

Soils along the terraces of the Athabasca, Dover and MacKay Rivers are generally Cumulic Regosols or Gleyed Cumulic Regosols on recent sandy and silty textured fluvial deposits (McMurray soils). The stream channels of smaller

Table 2
KEY TO SOIL TAXONOMIC CLASSIFICATION AND MAP UNITS IN LEASE 22.

Materials	TAXONOMIC CLASSIFICATION					MAPPING CONVENTIONS	
	Soil Order	Soil Subgroup	Soil Family	Soil Series	Soil Group	Soil Unit	Significant Other Soils
glaciofluvial sands	Brunisolic	Eluviated Dystric Brunisol	sandy, siliceous, acid very cold, subhumid	Mildred	Mildred	MIL1 MIL2	- Eluviated Eutric Brunisols - gleyed and gleysolic soils
	Gleysolic	peaty Rego Gleysol	sandy, loamy layers; mixed, calcareous, very cold, peraquic, peaty phase	Bitumount	Bitumount	BMT1 BMT2	- Gleyed Eluviated Dystric Brunisols - Terric Mesisols
glaciofluvial sands overlying gravelly sands	Brunisolic	Eluviated Dystric and Eutric Brunisols	sandy over sandy skeletal, alkaline, very cold, subhumid	Ruth Lake	Ruth Lake	RUT	- mapped with MIL
glaciolacustrine clays and silty clays	Luvisolic	Orthic Gray Luvisol	clayey - fine clayey, alkaline, montmorillonitic, very cold, humid	Dover	Dover	DOV1 DOV2 DOV3	 - gleyed and gleysolic soils - gleyed and gleysolic soils; often shallow over till
	Solonetzic	Gray Solod, Gray Solodized Solonetz	clayey - fine clayey, acid, montmorillonitic, very cold, humid	Joslyn	Joslyn	JSN1 JSN2	- Orthic Gray Luvisols - gleyed soils of JSN1 and common gleysolic soils
	Gleysolic	peaty Rego Gleysol	clayey - fine clayey, montmorillonitic, acid, very cold, peraquic, platy phase	Algar	Algar	ALG1 ALG2	- Orthic and Gleyed Gray Luvisols, various gleysolic subgroups - Terric Mesisols
recent fluvial sediments	Regosolic	Cumulic Regosol	coarse loamy, mixed, alkaline, very cold, humid	McMurray	McMurray	MMY1 MMY2	- common Gleyed Cumulic Regosols and inclusions of Rego Gleysols - dominantly Gleyed Cumulic Regosols with common Rego Gleysols
peat deposits (fens)	Organic	Terric Mesisol	fennic, euic, very cold, aqueous	series names not assigned	Eaglesham	EGL1	- inclusions of frozen soils
		Terric Mesisol	fennic, euic, very cold, aqueous, shallow	series names not assigned	Eaglesham	EGL2	- peaty Gleysols, inclusions of Terric Humisols
peat deposits (bogs)	Organic	Typic Mesisol Fibric Mesisol	sphagnic, euic and dysic, very cold, peraquic	series names not assigned	Kenzie	KNZ1	- inclusions of frozen soils
		Terric Mesisol	sphagnic, euic and dysic, very cold, peraquic, shallow	series names not assigned	Kenzie	KNZ2 KNZ3	- peaty Gleysols
	Cryosolic	Fibric Organic Cryosol, Mesic Organic Cryosol	sphagnic, dysic perennially frozen, peraquic	Mikkwa	Mikkwa	MKW	- mapped with KNZ

creeks were mapped as undifferentiated SC (stream channel) Miscellaneous Land Units. The river banks along the main rivers were mapped as RB (river bank) Miscellaneous Land Units.

Moderately well and imperfectly drained mineral soils account for 37%; poorly drained mineral soils for 25%; organic soils, with greater than 40 cm of peat, for 29%; and miscellaneous land units (DL, RB, SC) for 9% of Lease 22's area.

5.2 Soil Descriptions

The following section describes the general characteristics of the soil units that were mapped in the area. A key to the soil units is provided in Table 2 to enable correlation of soil units to taxonomic classification and parent materials. Detailed profile descriptions of soils are provided in Appendix A. A summary of the key properties of the soil units are provided with the general description and are discussed by materials in Section 5.3.1. The distribution patterns of soils in the area are shown on the Soil Maps (back pocket) and a summary of areal distribution of the soil units in Lease 22 is presented in Table 3.

5.2.1 Algar (ALG) Soils

Algar soils are poorly drained peaty Rego Gleysol soils developed on clays.

Landform and Associated Vegetation: Algar soils occur in depressions and on level surfaces in areas where runoff waters pond or groundwater discharges. The soils are associated with black spruce, willow, or hygric aspen communities.

Soil Classification and Morphology: The Algar soil series is a peaty Rego Gleysol with an Om, Cg horizon sequence developed on glaciolacustrine or recent lacustrine clays. The Om is a relatively thick (15-40 cm) mesic peaty mor composed of moderately decomposed mosses and herbaceous materials. The Cg is

Table 3

SUMMARY OF DISTRIBUTION OF SOIL MAP UNITS
ON SYNCRUDE LEASE 22

Soil Map Unit	Hectares	% of Area
ALG1	549.6	2.8
ALG1-KNZ3	957.7	4.9
ALG2	343.9	1.7
BD	255.4	1.3
BD-ALG1-KNZ3	514.8	2.6
BD-SC	133.5	0.7
BMT1	83.2	0.4
BMT1-ALG1	42.4	0.2
BMT2	380.9	1.9
BMT2-ALG2	42.3	0.2
DL	758.2	3.8
DOV1	2211.5	11.4
DOV2	2762.0	14.4
DOV2-KNZ3	154.6	0.8
DOV2-MIL2	329.8	1.7
DOV3	221.2	1.1
EGL1	150.7	0.8
EGL2	278.9	1.4
JSN1	411.7	2.1
JSN2	163.5	0.8
KNZ1	1220.1	6.2
KNZ1-MKW	919.2	4.7
KNZ2	1191.7	6.1
KNZ2-MIL2	255.8	1.3
KNZ3	1313.7	6.8
KNZ3-EGL2	259.8	1.3
MMY1	91.4	0.5
MMY2	879.2	4.5
MIL1	697.1	3.5
MIL1-KNZ3	67.1	0.3
MIL1-RUT	406.7	2.1
MIL2	389.3	2.0
RB	854.5	4.3
SC	227.7	1.1
SC-EGL2	60.9	0.3
TOTAL	19,600	100

clay textured; dark grayish brown; mottled; massive; and firm. The presence of mottling indicates a seasonally high watertable.

Variations in profiles and materials occur within areas mapped as Algar soils. Inclusions of Orthic Gleysols and Terric Mesisols are common, and the materials often include lenses of sand, silts and silty clays.

Soil Units: Two soil units were recognized: Algar 1 (ALG1) is dominantly peaty Rego Gleysols (>40%) with significant (15-40%) Orthic Gleysols, Gleyed Gray Luvisols and Orthic Gray Luvisols (Dover series); Algar 2 (ALG2) is dominantly peaty Rego Gleysols with significant Terric Mesisols (Kenzie or Eaglesham soil series).

Soil Environment: Algar soils are wet and cold. These soils are flooded in May and June and are saturated for the remainder of the growing season. Infiltration and permeability rates are very slow. The soils have a very cold temperature regime (mean annual soil temperature is in the range of -7 to 2°C and are frozen from November to June (Knapik and Westworth, 1982). Plant growth is restricted by flooding; saturated, anaerobic conditions; an extended frozen period; and cold soil temperatures during the latter part of the growing season.

5.2.2 Bitumount (BMT) Soils

Bitumount soils are poorly drained peaty Rego Gleysols developed on sands.

Landform and Associated Vegetation: Bitumount soils occupy level and depressional positions in glaciofluvial landscapes in areas where runoff waters pond or groundwater discharges. The soils are associated with white and black spruce, or hygric aspen communities.

Soil Classification and Morphology: The Bitumount soil series is defined as a peaty Rego Gleysol developed on glaciofluvial sand. The soils have a relatively thick (15-40 cm) Om horizon classified as a mesic peaty mor, over-

lying a Cg. The Cg horizons are usually loamy sand to sand textured; yellowish brown; mottled; with single grain structure. Layers of finer textured materials commonly occur in the Cg. Mottling indicates a fluctuating watertable.

Soil Units: Two soil units were recognized: Bitumount 1 (BMT1) is dominantly peaty Rego Gleysols with significant Orthic Luvic Gleysols and Gleyed Eluviated Dystric Brunisols; Bitumount 2 (BMT2) is dominantly peaty Rego Gleysols with significant Terric Mesisols.

Soil Environment: Bitumount soils are wet and cold. The ecological moisture regime varies from subhygric to subhydric indicating the soils are wet throughout the growing season. Wetness is usually due to seepage. The soils are frozen from November to June and are classified in the very cold soil temperature class. Plant growth is restricted by wetness and the extended frozen period.

5.2.3 Dover (DOV) Soils

Dover soils are moderately well drained Orthic Gray Luvisols developed on glaciolacustrine clays.

Landform and Associated Vegetation: Dover soils occur bordering the MacKay and Dover River channels and in the southwestern corner of Lease 22 on slightly elevated positions on the generally level glaciolacustrine plain. Land surfaces are level or slightly convex. Dover soils usually occur under aspen or aspen-white spruce forests.

Soil Classification and Morphology: Dover soils are Orthic Gray Luvisols developed on glaciolacustrine clays (Plate 4). Orthic Gray Luvisols have an LF, Ae, Bt, BC, C, (Ck) horizon sequence. The LF horizon is a relatively thin (5-10 cm) fibrimor, composed of slightly decomposed broad leaves and herbaceous fragments. The friable Ae horizons are loamy fine sand textured; grayish brown; with moderate fine platy structure. Beneath the Ae is the very dark

gray; moderately fine, subangular blocky; firm; clay textured Bt. The BC and C are usually clay textured with dark gray or pinkish-gray colors. The soils are usually stonefree but may be slightly stony. A summary of their properties is provided in Table 4 and discussed in Section 5.3.

Soil Units: Three soil units were recognized: Dover 1 (DOV1) is dominantly Orthic Gray Luvisols with less than 20% of Gleyed Gray Luvisols and Gray Solods (Joslyn soil series); Dover 2 (DOV2) is dominantly Orthic Gray Luvisols with significant Gleyed Gray Luvisols, Orthic Luvic Gleysols or peaty Rego Gleysols; Dover 3 (DOV3) is dominantly Orthic Gray Luvisols with significant gleyed and gleysolic soils developed on less than 1 m of glaciolacustrine clays overlying moderately fine textured till.

Soil Environment: Dover soils are characterized by mesic to submesic ecological moisture regimes. The soils have high available water capacity but levels of available water reflect climatic inputs. Infiltration and permeability rates are slow. The soils are cold; being frozen from November to mid May; and warm slowly due to fine textures.

5.2.4 Eaglesham (EGL) Soils

Eaglesham soils are Organic (peat) soils developed on fen peatlands.

Landform and Associated Vegetation: Eaglesham soils occur in a few level plains in the lowest positions in the landscape, in old drainage channels, where watertable levels are maintained by seepage and ponded runoff waters. These soils are also found complexed with Kenzie soils in patterned bogs but were not separated due to their small size and similarity in materials. Eaglesham soils are associated with sedge-alder or sedge-willow-bog birch-moss vegetation (Plate 5).

Soil Classification and Morphology: A large number of unnamed soil series are encompassed by the soil name Eaglesham, which refers to Organic soils developed on fens. Terric Mesisols are the most common soil, although there

Table 4
SUMMARY OF KEY SOIL PROPERTIES OF DOVER SOILS

	Horizon				
	LF	Ae	Bt	BC	C or Ck
pH	5.1(4.3-5.6)/3/0.6*	5.8(4.2-7.8)/11/1.0	5.6(4.4-7.9)/12/1.1	6.7(4.5-7.9)/10/1.3	8.0(7.5-8.2)/9/0.2
EC (mS/cm)	----	0.5(---)/1/0.0	0.4(0.3-0.5)/2/0.1	1.6(0.3-4.0)/5/1.5	2.5(0.5-7.3)10/2.8
Org. C (kg/ha)	23(12-29)/4/8	11(6-24)/12/7	----	----	----
Total N (kg/ha)	0.7(0.6-0.7)/3/0.6	0.8(0.1-2.5)/12/0.6	----	----	----
C:N	31(19-39)/3/11	14(6-21)/11/4	----	----	----
Exchangeable Cations (meq/100g)					
Ca	13.3(8.8-17.4)/3/4.3	4.3(0.9-15.4)/7/5.0	9.7(7.1-14.4)/7/2.6	11.0(10.6-13.5)/6/2.1	20.6(11.4-30.1)/7/8.0
Mg	3.2(2.1-5.4)/3/1.9	0.9(0.1-1.9)/7/0.6	6.8(4.3-12.9)/7/3.8	8.1(4.1-12.7)/6/3.6	6.6(2.3-13.5)/6/4.3
K	0.6(0.5-0.6)/3/0.1	0.1(0.1-0.2)/7/0.0	0.3(0.2-0.5)/7/0.1	0.3(0.2-0.4)/6/0.1	0.2(0.1-0.5)/6/0.1
Na	0.2(0.1-0.2)/2/0.1	0.05(0.0-0.2)/6/0.1	0.3(0.1-1.3)/6/0.5	0.5(0.1-1.8)/5/0.7	0.8(0.2-3.0)/5/1.2
CEC	29.1(26.2-33.9)/3/4.2	6.6(4.2-11.3)/8/2.7	19.5(15.3-23.3)/7/3.6	16.3(7.9-23.1)/5/7.4	17.1(13.5-21.5)/4/3.3
ESP	0.5(0.4-0.6)/3/0.1	1.0(0.0-4.8)/7/1.9	1.4(0.5-5.7)/7/1.9	3.2(0.6-9.7)/6/3.4	4.8(1.2-14.0)/6/5.2
% Base Sat.	61(35-77)/3/23	67(18-100)/7/28	86(60-100)/7/14	95(80-100)/6/8	100(100-100)/7/0

* Reported as Mean (Range)/N/Standard Deviation

can be inclusions of Terric Humisols under the sedge-alder vegetation and Terric Fibric Organic Cryosols and Terric Fibrisols under sedge-willow-bog birch-moss vegetation. Terric Mesisols are developed on 40 - 160 cm of moderately decomposed sedges and mosses. The underlying mineral soil is usually clay-textured but sands, gravelly sands and gravelly clays occur occasionally. The properties of the Terric Mesisols of the Eaglesham soils are summarized in Table 5.

Soil Units: Two soil units were recognized: Eaglesham 1 (EGL1) is dominantly Terric Mesisols with significant frozen soils (Terric Fibric Organic Cryosols). The peat is generally 60 - 120 cm deep. Eaglesham 2 (EGL2) is dominantly Terric Mesisols with significant peaty Rego Gleysols (Algar or Bitumount soil series). The peat is generally 25 to 80 cm deep.

Soil Environment: Watertable levels are at or near the soil surface throughout the growing season resulting in a hydric moisture regime. Soil pH ranges from slightly acid to neutral and the exchange complex is dominated by calcium and magnesium. CEC values are high and C:N ratios of the peat are high. Bulk density values of the peat are in the order of 0.1 g/cm3 and the pore space is filled with water. The soils are anaerobic and are very cold. The frozen period extends from November to June, with discontinuous lenses of ice persisting to late summer.

5.2.5 Joslyn (JSN) Soils

Joslyn soils are classified as Gray Solod or Gray Solodized Solonetzic soils developed on clay and silty clay textured glaciolacustrine sediments. They do not occur as a pure unit but include significant Orthic Gray Luvisols (Dover soil series).

Landform and Associated Vegetation: Joslyn soils are of minor areal extent and are confined to moderately well to imperfectly drained areas on slightly elevated landform positions on the generally level glaciolacustrine plain. Joslyn soils usually occur under aspen, or aspen-white spruce forests.

Table 5
SUMMARY OF KEY SOIL PROPERTIES OF EAGLESHAM (Terric Mesisol) SOILS

	Horizon		
	Om	Om	Cg
pH	5.9(5.5-6.1)/3/0.3*	5.7(5.3-6.1)/3/0.4	5.7(5.3-6.2)/3/0.5
Org. C (kg/ha)	---- 795(655-986)/3/171	(Om av. 70cm) ----	----
Total N (kg/ha)	-- 22.0(14.0-29.0)/3/7.6	(Om av. 70cm) --	----
C:N	37(29-48)/3/10	43(26-67)/3/21	----
Exchangeable Cations (meq/100g)			
Ca	50.9(48.0-55.3)/3/3.9	50.8(38.0-58.8)/3/11.2	12.5(10.0-14.5)/3/2.3
Mg	14.2(9.7-20.5)/3/5.6	13.2(5.4-21.3)/3/8.0	3.8(2.6-4.6)/3/1.2
K	0.2(0.1-0.3)/3/0.1	0.1(0.1-0.2)/3/0.1	0.2(0.1-0.2)/3/0.1
Na	0.9(0.6-1.2)/3/0.3	0.8(0.5-1.2)/3/0.4	0.2(0.2-0.2)3/0.0
CEC	84.3(64.3-117/3/28.5	72.5(66.9-77.7)/3/5.4	15.8(14.5-17.1)/3/1.3
ESP	0.7(0.6-0.8)/3/0.1	1.1(0.7-1.6)/3/0.5	1.5(1.3-1.7)/3/0.2
% Base Sat.	84(56-98)/3/24	89(66-100)/3/20	94(97-100)/3/7
Ash	13.6(13.1-14.5)/3/0.8	12.9(10.6-14.6)/3/2.1	----
% Fibre			
Unrubbed	79(78-80)/3/1	74(72-76)/3/2	----
Rubbed	53(44-66)/3/11	49(38-58)/3/10	----
Pyro. Index	0(-1-1)/3/1	0(-1-0.5)/3/1	----

* Reported as Mean (Range)/N/Standard Deviation

Soil Classification and Morphology: Joslyn soils are Gray Solods or Gray Solodized Solonetz developed on glaciolacustrine clays. Gray Solods have an LF, Ae, AB, Bnt, BC, C (Ck) horizon sequence, and Gray Solodized Solonetz have an LF, Ae, Bnt, BC, C (Ck) horizon sequence. The LF is a thin fibrimor (5-10 cm thick) composed of slightly decomposed broad leaves and herbaceous materials. The Ae is fine sandy loam textured; grayish brown; and has strong coarse platy structure. The AB is clay to silty clay loam with columnar and strong medium prismatic structure; the Bnt is very dark gray clay with strong prismatic structure sometimes breaking to strong coarse subangular blocky structure of firm consistence. The BC and C are usually clay textured with dark gray or pinkish-gray colors. The soils are usually stone-free. Table 6 summarizes the properties of Joslyn soils.

Soil Units: Two soil units were recognized: Joslyn 1 (JSN1) occur on moderately well drained sites and include Gray Solods and Gray Solodized Solonetzic soils with significant Orthic Gray Luvisols; Joslyn 2 (JSN2) occur on imperfectly drained sites and include Gleyed Gray Solods and Gleyed Gray Solodized Solonetzic soils with significant Gleyed Gray Luvisols and inclusions of peaty Rego Gleysols.

Soil Environment: Joslyn soils are characterized by mesic to submesic ecological moisture regimes. The soils have high available water capacity but levels of available water reflect climatic inputs. Infiltration and permeability rates are slow. The soils are cold; being frozen from November to mid May; and warm slowly due to their fine textures.

5.2.6 Kenzie (KNZ) Soils

Kenzie soils are very poorly drained organic soils developed on bogs.

Landform and Associated Vegetation: Kenzie soils occupy a major portion of the study area on level or depressional areas where water ponds. These soils generally occur in blanket bogs, horizontal bogs and occasionally mounded bogs. They are complexed with Eaglesham soils (fen peat) in patterned bogs and Mikkwa

Table 6
SUMMARY OF KEY SOIL PROPERTIES OF JOSLYN SOILS

	Horizon				
	LF	Ae	Bnt	BC	C or Ck
pH	4.5(---)/1/0.*	5.7(5.1-6.6)/4/0.6	6.0(4.7-7.0)/4/1.0	7.7(7.1-8.1)/3/0.5	8.1(7.9-8.3)/4/0.2
EC (mS/cm)	----	----	3.5(---)/1/0.0	2.3(0.8-3.1)/3/1.3	1.9(0.9-3.6)/3/1.5
Org. C (kg/ha)	39(---)/1/0.0	22(10-42)/4/14	----	----	----
Total N (kg/ha)	1.1(---)/1/0.0	1.4(0.5-3.4)/4/1.3	----	----	----
C:N	36(---)/1/0.0	17(12-20)/4/3	----	----	----
Exchangeable Cations (meq/100g)					
Ca	11.2(---)/1/0.0	2.4(2.3---2.4)/2/0.1	9.1(8.6-9.6)/2/0.7	22.4(11.6-33.3)/2/15.3	21.6(16.8-26.3)/2/6.7
Mg	2.2(---)/1/0.0	1.5(1.5-1.5)/2/0.0	7.7(6.2-9.2)/2/2.1	6.9(6.7-7.1)/2/0.3	6.8(6.7-6.8)/2/0.1
K	1.1(---)/1/0.0	0.1(0.1-0.1)/2/0.0	0.2(0.2-0.2)/2/0.0	0.2(0.2-0.2)/2/0.0	0.2(0.2-0.3)/3/0.1
Na	0.2(---)/1/0.0	0.2(0.2-0.2)/2/0.0	2.5(1.7-3.3)/2/1.1	2.7(2.0-3.4)/2/1.0	3.1(2.6-3.6)/2/0.7
CEC	29.9(---)/1/0.0	8.0(7.2-8.8)/2/1.1	20.1(18.5-21.7)/2/2.3	16.3(15.3-17.3)/2/1.4	15.8(14.3-17.3)/2/2.1
ESP	0.7(---)/1/0.0	2.6(2.3-2.8)/2/0.4	12.2(9.2-15.2)/2/4.2	16.4(13.1-19.7)/2/4.7	19.5(18.2-20.8)/2/1.8
% Base Sat.	49(---)/1/0	53(48-57)/2/6	95(90-100)/2/7	100(100-100)/2/0	100(100-100)/2/0

* Reported as Mean (Range)/N/Standard Deviation

soils in mounded bogs. Kenzie soils are associated with black spruce-labrador tea-Sphagnum moss communities.

Soil Classification and Morphology: Several unnamed soil series are included in the soil name Kenzie, which refers to Organic soils developed on bogs, Terric Mesisols are the most common soil subgroup. They have an Om, Cg horizon sequence. The Om is from 40 to 160 cm thick, is composed of moderately decomposed mosses and herbaceous material, and is classified as a mesic peaty mor. The Cg is generally clay textured, has a massive structure and is strongly gleyed. Close to the Athabasca River the parent material is generally glaciofluvial in origin and varies from sand to silty clay loam textured. Other soil subgroups include Typic Mesisols, which have 160 to 250 cm of peat overlying mineral material, Fibric Mesisols, and Mesic or Fibric Organic Cryosols. Kenzie soils occasionally had lenses (20-30 cm thick) of seasonal ice at the time of the soil survey. Key soil properties of the Terric Mesisols are summarized in Table 7; the less commonly occuring Terric Humisols, and Terric Fibrisols are summarized in Tables 8 and 9 respectively; and the Typic Mesisols are summarized in Table 10.

Soil Units: Three soil units were recognized. Kenzie 1 (KNZ1) has deeper peat materials (100 to 250 cm) that have inclusions of permafrost. The subgroups are dominantly Typic Mesisols, Fibric Mesisols with significant inclusions (approximately 20%) of Mesic and Fibric Organic Cryosols (Mikkwa soil series). Kenzie 2 (KNZ2) is dominantly Terric Mesisols with significant peaty Rego Gleysols (Algar or Bitumount soil series). The peat blanket is generally 25 to 80 cm deep. Kenzie 3 (KNZ3) is a relatively pure unit of Terric Mesisols with 40 to 120 cm of peat blanket.

Soil Environment: Water table levels are at or near the soil surface throughout the growing season, resulting in a subhydric moisture regime. The frozen period extends from November to mid-summer, with discontinuous lenses of ice persisting to late summer in many locations. Soil pH ranges from strongly to moderately acid in the peat layers and is acid to alkaline in underlying mineral materials. The soils are under anaerobic conditions except

Table 7
SUMMARY OF KEY SOIL PROPERTIES OF KENZIE (Terric Mesisol) SOILS

	Horizon		
	Of	Om	Cg
pH	5.1(3.2-6.4)/9/1.1*	5.3(3.6-6.7)/9/0.9	6.1(4.8-7.6)/8/0.8
Org. C (kg/ha)	454(280-634)/8/109	337(227-520)/8/110	337(---)/1/0
Total N (kg/ha)	11.8(7.4-20.0)/9/4.6	9.2(5.5-16.0)/9/3.6	----
C:N	46(28-86)/9/20	39(27-65)/9/11	----
Exchangeable Cations (meq/100g)			
Ca	23.8(7.3-49.5)/9/14.2	29.7(8.5-47.0)/9/13.9	16.0(4.7-39.4)/8/12.4
Mg	11.8(2.3-21.6)/9/7.4	10.4(3.1-19.0)/9/5.6	4.7(2.0-11.3)/8/2.9
K	0.3(0.1-0.9)/9/0.3	0.1(0.1-0.2)/9/0.1	0.2(0.1-0.2)/8/0.1
Na	0.8(0.0-2.0)/9/0.6	0.8(0.1-1.7)/9/0.5	0.5(0.1-1.7)/9/0.5
CEC	63.8(36.4-103.0)/9/19.1	64.8(10.5-85.7/9/21.9	22.6(3.9-81.8)/8/24.4
ESP	1.4(0.0-4.4)/8/1.4	1.2(0.2-2.6)/8/0.7	2.3(0.6-3.7)/7/1.1
% Base Sat.	58(18-94)/9/28	65(26-97)/9/21	90(68-100)/9/12
Ash	9.8(4.2-15.9)/9/4.3	12.0(4.3-14.4)/9/4.9	----
% Fibre			
Unrubbed	81(66-96)/9/9	74(52-92)/9/11	----
Rubbed	61(42-82)/9/13	50(30-76)/9/16	----
Pyro. Index	3/9/2	1/9/2	----

* Reported as Mean (Range)/N/Standard Deviation

Table 8
SUMMARY OF KEY SOIL PROPERTIES OF KENZIE (Terric Humisol) SOILS

	Horizon		
	Om	Oh	Cg
pH	6.7(5.9-7.4)/2/1.1*	6.0(5.8-6.3)/2/0.4	7.0(6.6-7.3)/2/0.5
Org. C (kg/ha)	773(688-858)/2/120	----	----
Total N (kg/ha)	32.5(31.0-34.0)/2/2.1	----	----
C:N	27(26-27)/2/1	20(20-21)/2/1	----
Exchangeable Cations (meq/100g)			
Ca	41.9(37.6-46.1)/2/6.0	78.2(42.5-114.0)/2/50.6	13.8(11.7-15.8)/2/2.9
Mg	13.2(12.1-14.3)/2/1.6	15.4(10.6-20.3)/2/6.8	4.6(4.5-4.7)/2/0.1
K	0.5(0.1-0.9)/2/0.6	0.1(0.1-0.1)/2/0.0	0.2(0.2-0.2)/2/0.0
Na	0.9(0.6-1.2)/2/0.4	1.2(0.5-1.9)/2/1.0	0.5(0.2-0.8)/2/0.4
CEC	65.4(57.1-73.7)/2/11.7	94.2(60.3-128.0)/2/47.9	17.0(14.9-19.1)/2/3.0
ESP	1.4(0.8-2.1)/2/0.9	1.2(0.8-1.5)/2/0.5	2.8(1.3-4.2)/2/2.0
% Base Sat.	87(83-91)/2/6	94(89-100)/2/8	100(100-100)/2/0
Ash	14.4(10.7-18.2)/2/5.3	36.9(30.6-43.1)/2/8.8	----
% Fibre			
Unrubbed	58(52-64)/2/8	46(42-50)/2/6	----
Rubbed	38(28-48)/2/14	16(10-22)/2/8	----
Pyro. Index	0/2/2	1/2/1	----

* Reported as Mean (Range)/N/Standard Deviation

Table 9
SUMMARY OF KEY SOIL PROPERTIES OF KENZIE (Terric Fibrisol) SOILS

	Horizon			
	Of	Of	Of	Cg
pH	4.5(3.4-6.4)/4/1.3*	4.6(3.5-5.8)/4/1.0	4.9(3.9-5.7)/4/0.8	5.7(---)/1/0.0
Org. C (kg/ha)	---------- 1157(824-1537)/5/270 (Of - av. 90 cm) ----------			----
Total N (kg/ha)	---------- 21.3(17.4-23.8)/3/3.4 (Of - av. 90 cm) ----------			----
C:N	57(56-58/3/1	69(57-82)/3/12	59(48-70)/3/11	----
Exchangeable Cations (meq/100g)				
Ca	11.1(8.3-12.8)/3/2.5	19.2(12.3-27.5)/3/7.7	33.9(16.9-51.0)/3/17.0	15.3(---)/1/0.0
Mg	4.0(2.0-5.2)/3/1.7	5.5(2.1-8.0)/3/3.1	5.6(2.4-7.6)/3/2.8	----
K	0.4(0.3-0.5)/3/0.1	0.1(0.1-0.1)/3/0.0	0.1(0.1-0.1)/3/0.0	0.3(---)/1/0.0
Na	0.5(0.1-1.1)/3/0.6	0.4(0.1-0.9)/3/0.4	0.3(0.1-0.6)/3/0.3	0.2(---)/1/0.0
CEC	117.3(45.7-243.0)/3/109.2	60.6(55.7-67.1)/3/5.8	65.2(55.7-74.9)/3/9.6	20.3(---)/3/0.0
ESP	0.7(0.0-1.7)/3/0.9	0.7(0.1-1.6)/3/0.8	0.5(0.2-0.8)/3/0.3	1.0(---)/1/0.0
% Base Sat.	27(4-40)/4/16	42(22-61)/4/16	58(35-89)/4/23	----
Ash	4.8(3.6-6.4)/4/1.3	5.3(3.4-6.9)/3/1.8	7.4(3.9-11.0)/3/3.5	----
% Fibre				
Unrubbed	84(68-90)/4/10	88(82-92)/4/4	84(80-88)/4/4	----
Rubbed	66(46-76)/4/14	68(62-76)/4/6	68(58-74)/4/7	----
Pyro. Index	3/2/1	5/2/1	2/2/3	----

* Reported as Mean (Range)/N/Standard Deviation

Table 10
SUMMARY OF KEY SOIL PROPERTIES OF KENZIE (Typic Mesisol) SOILS

	Horizon		
	T	M	B
pH	3.6(3.2-4.1)/5/0.3*	3.8(3.4-4.1)/5/0.3	4.6(4.0-5.1)/5/0.5
Org. C (kg/ha)	1405(963-1690)/5/282	----	----
Total N (kg/ha)	47.4(21.2-118.0)/5/40.7	----	----
C:N	71(52-81)/4/13	65(58-86)/4/14	47(26-78)/4/19
Exchangeable Cations (meq/100g)			
Ca	6.7(3.0-10.7)/4/3.4	10.2(6.4-17.1)/4/4.8	21.3(15.5-30.5)/4/6.6
Mg	3.3(1.4-6.1)/4/2.2	4.4(1.9-8.1)/4/2.7	6.9(4.4-8.7)/4/2.2
K	0.3(0.1-0.4)/4/0.1	0.2(0.1-0.3)/4/0.1	0.1(0.1-0.1)/4/0.0
Na	0.3(0.1-0.4)/4/0.2	0.2(0.1-0.3)/4/0.1	0.3(0.1-0.4)/4/0.1
CEC	43.8(22.2-56.6)/4/16.2	58.6(42.3-69.4)/4/11.6	63.7(61.4-65.4)/4/1.7
ESP	0.5(0.4-0.7)/3/0.2	0.4(0.3-0.5)/3/0.1	0.4(0.3-0.5)/3/0.1
% Base Sat.	25(13-33)/4/9	26(12-41)/4/13	44(31-58)/4/13
Ash	3.9(3.4-4.1)/4/0.3	4.1(3.4-4.9)/4/0.6	6.7(4.8-9.1)/4/2.2
% Fibre			
Unrubbed	90(86-94)/4/4	86(74-96)/4/10	80(76-88)/4/6
Rubbed	78(74-82)/4/4	66(50-78)/4/12	56(34-74)/4/16
Pyro. Index	4/5/2	2/5/2	2/5/2

* Reported as Mean (Range)/N/Standard Deviation

for surface layers in mounded areas. The saturated, anaerobic conditions; very cold temperatures; and low pH limit the productivity of these soils, and restrict the vegetation to bog communities.

5.2.7 McMurray (MMY) Soils

McMurray soils are Regosolic and Gleysolic soils that occur on terraces of the larger creeks and rivers.

Landform and Associated Vegetation: McMurray soils occupy freely drained and imperfectly drain terraces along the Athabasca, Dover and MacKay Rivers. These soils are generally associated with aspen-white spruce, or hygric aspen communities.

Soil Classification and Morphology: McMurray soils are typically Cumulic Regosols or Gleyed Cumulic Regosols developed on recent fluvial materials. Cumulic Regosols occur on the freely drained sites and have an LF, C1, Ahb, C2 horizon sequence. The LF is a thin (5 to 10 cm), fibrimor composed of slightly decomposed broad leaves and herbaceous fragments. The C1 horizon is usually silt loam textured; gray; and has weak, medium, pseudoplaty structure. McMurray soils on imperfectly drained sites have gleyed or mottled C horizons indicating seasonally high water tables. They may be poorly drained and have peat accumulation (<40 cm deep) on their surface. Buried surface horizons (Ahb and LFb) are common. The Ahb is thin (5 to 8 cm); silt loam; black; and has massive structure. The C1, Ahb and C2 horizons are all friable. There are no coarse fragments in these soils.

Soil Units: Two soil units were recognized. McMurray 1 (MMY1) are dominantly Cumulic Regosols on the better drained sites with significant Gleyed Cumulic Regosols. McMurray 2 (MMY2) are dominantly Gleyed Cumulic Regosols with significant Rego Gleysols and inclusions of peaty Rego Gleysols. These soils occur on the lower terraces that are inundated when the streams flood.

Soil Environment: McMurray soils are occasionally flooded and receive deposition of fresh sediments on their surface. The sediments are often calcareous and are fine sand to silt-sized. Soils of the MMY1 map unit are freely drained, moderately permeable, well aerated, and they warm rapidly in the early summer. The MMY2 soils are flooded annually and have high water table levels throughout the growing season.

5.2.8 Mikkwa (MKW) Soils

Mikkwa soils are permanently frozen soils developed on peatlands. These soils contain hard ice layers at depths of less than one metre at the end of the summer.

Landform and Associated Vegetation: Mikkwa soils usually occur on mounded bogs (Plate 6), although they may also be found on horizontal bogs. These soils only occur complexed with bog soils (Kenzie soils) in the study area and have black spruce-Sphagnum moss vegetation.

Soil Classification and Morphology: Mikkwa soils are dominantly Fibric Mesic Organic Cryosols developed on bog peat. A typical Mesic Organic Cryosol has an Om, Of to Omz, Om2, Omz2 horizon sequence. The Of-Om is usually 20 - 40 cm thick, and is a fibric or mesic peaty mor. The Omz1 is moderately thick (30-40 cm); is frozen; is composed of moderately decomposed bog peat, and is classified as a mesic peaty mor. The Om2 is usually 20 - 40 cm thick and is composed of moderately decomposed peat and overlays another Omz horizon at approximately 100 cm. The peat can be up to 300 cm deep. Mikkwa soil properties are summarized in Table 11.

Soil Unit: Only one soil unit of Mikkwa soil has been recognized. It includes Fibric and Mesic Organic Cryosolic soils, and is mapped in conjunction with Kenzie 1 soils (KNZ1-MKW). The Kenzie 1 soils (Typic and Fibric Mesisols) dominate the map unit.

Table 11
SUMMARY OF KEY SOIL PROPERTIES OF MIKKWA (Mesic Organic Cryosol) SOILS

	Horizon		
	Of-Om	Om2	Om
pH	4.1(3.4-5.7)/4/1.1*	4.3(3.5-5.7)/4/1.0	4.5(3.6-5.3)/2/1.2
Org. C (kg/ha)	411(314-534)/3/112	445(365-534)/3/85	508(459-557)/2/69
Total N (kg/ha)	8.9(4.0-18)/3/7.9	13.0(11.0-16.0)/3/2.9	10.0(6.9-13.0)/2/4.3
C:N	62(51-80)/3/15	45(32-52)/3/11	58(48-67)/2/13
Exchangeable Cations (meq/100g)			
Ca	4.8(2.6-6.9)/2/3.0	12.2(6.8-17.6)/2/7.6	18.9(6.9-30.9)/2/16.9
Mg	2.2(1.2-3.1)/2/1.3	5.2(3.6-6.7)/2/2.2	6.2(3.9-8.6)/2/3.3
K	0.2(0.2-0.2)/2/0.0	0.2(0.1-0.2)/2/0.1	0.1(0.1-0.1)/2/0.0
Na	0.2(0.1-0.2)/2/0.1	0.5(0.3-0.7)/2/0.3	0.6(0.4-0.8)/2/0.3
CEC	36.6(35.1-38.0)/2/2.0	59.2(53.7-64.6)/2/7.7	62.2(55.4-69.1)/2/9.7
ESP	0.4(0.3-0.5)/2/0.1	0.9(0.5-1.3)/2/0.6	1.0(0.6-1.4)/2/0.6
% Base Sat.	20(14-27)/2/9	30(21-38)/2/12	40(21-58)/2/26
Ash	3.76(2.6-5.8)/3/1.8	4.3(3.4-4.9)/3/0.8	4.8(2.4-7.3)/2/3.5
% Fibre			
Unrubbed	82(76-92)/3/9	82(74-90)/3/8	85(82-88)/2/4
Rubbed	72(62-86)/3/12	69(64-74)/3/5	68(60-76)/2/11
Pyro. Index	4/4/1	1/4/2	6/2/2

* Reported as Mean (Range)/N/Standard Deviation

Soil Environment: Permafrost occurs within 100 cm of the surface of Mikkwa soils. The soils are grouped in the extremely cold temperature class and have a hygric or subhydric moisture regime. Water table levels are near the surface throughout the year. The soils materials are peat, usually of dominantly Sphagnum moss origin and have very acidic pH levels.

5.2.9 Mildred (MIL) Soils

Mildred soils are Eluviated Dystric Brunisols developed on glaciofluvial sands (Plate 7).

Landform and Associated Vegetation: Mildred soils occur on the undulating to rolling glaciofluvial landscapes of the plain. They occupy freely drained slope positions under jackpine, aspen, or aspen-white spruce forests.

Soil Classification and Morphology: The Mildred soil series is defined by Eluviated Dystric Brunisols with occasional Eluviated Eutric Brunisols developed on glaciofluvial sands with an LF, Ae, Bm, BC, C horizon sequence. The LF horizon is a relatively thin (5 - 10 cm) fibrimor composed of slightly decomposed coniferous needles and herbaceous fragments. The Ae horizon is loamy fine sand; yellowish brown; and has weak, very fine, platy structure. Beneath the Ae is the loamy medium sand; dark yellowish brown; single grain structured Bm horizon. The Ae, Bm, BC and C horizons all have loose consistence. These soils occasionally occur on ridged glaciofluvial veneers that overlay weathered tar sands within one metre.

Soil Units: Two soil units were recognized: Mildred 1 (MIL1) soils are a relatively pure unit of Eluviated Dystric Brunisols on glaciofluvial sands. Occasionally they have a pH >5.5 and are Eluviated Eutric Brunisols. Mildred 2 (MIL2) soils are dominantly Eluviated Dystric Brunisols with significant gleyed Eluviated Dystric Brunisols, Orthic Luvic Gleysols and peaty Rego Gleysols.

Soil Environment: Mildred soils have xeric and subxeric ecological moisture regimes and cold temperatures. Infiltration and permeability rates

are rapid due to sand or loamy sand textures and the amount of plant-available water is low (5 cm in top metre). Water is removed rapidly in relation to supply and soils are moist for short periods following precipitation. The frozen period extends from November to mid-May. Cation exchange capacity of the mineral horizons is very low, and the soils are usually strongly acid. Mean pH values in the solum are 5.3 - 5.5 and in the lower profile are 5.7 (Table 12).

5.2.10 Ruth Lake (RUT) Soils

Ruth Lake soils are well drained Brunisols developed on glaciofluvial sands and silts overlying gravels or gravelly, cobbly sands.

Landform and Associated Vegetation: Ruth Lake soils occur mainly on the Embarras Plain adjacent to the Athabasca River. They are of minor areal extent and occur complexed with Mildred soils. To be a Ruth Lake soil, gravelly and cobbly sands must occur within 1.5 m of the surface. Parent materials are glacial meltwater channel deposits. Ruth Lake soils are associated with aspen or aspen-white spruce forest.

Soil Classification and Morphology: The Ruth Lake soil series is defined as Eluviated Dystric Brunisols and Eluviated Eutric Brunisols developed on sandy gravelly glaciofluvial materials. The Eluviated Dystric Brunisols have an LF, Ae, Bm, BC, C horizon sequence. The LF is a relatively thin (5 to 10 cm) fibrimor composed of slightly decomposed broad leaves and herbaceous fragments. The Ae horizon is fine sandy; light brownish gray; and has very weak, fine platy structure. Beneath the Ae horizon is the fine loamy sand textured; dark yellowish brown; single grain structured Bm horizon. The BC and C horizons are often gravelly and contain a high percentage of coarse fragments. Eluviated Eutric Brunisols have a similar soil profile but their pH is >5.5 whereas Dystric Brunisols have a pH <5.5. A summary of Ruth Lake soil properties is provided in Table 13.

Table 12
SUMMARY OF KEY SOIL PROPERTIES OF MILDRED SOILS

	Horizon			
	LFH	Ae	Bm	BC
pH	5.6(5.1-6.1)/2/0.7*	5.3(3.8-7.3)/7/1.2	5.5(3.7-6.7)/8/1.0	5.7(3.8-7.3)/7/1.0
EC (mS/cm)	----	----	----	0.2(---)/1/0.0
Org. C (kg/ha)	59(8-110)/2/72	9(3-18)/7/5	----	----
Total N (kg/ha)	----	0.5(0.3-0.8)/7/0.2	----	----
C:N	----	19(8-21)/7/8	----	----
Exchangeable Cations (meq/100g)				
Ca	----	2.0(0.1-3.7)/5/1.3	1.1(0.4-2.7)/5/1.0	0.5(0.1-1.5)/5/0.1
Mg	----	0.4(0.1-1.2)/5/0.4	0.6(0.0-1.9)/5/0.7	0.3(0.0-1.0)/5/0.4
K	----	0.1(0.1-0.2)/5/0.0	0.2(0.1-0.3)/5/0.1	0.1(0.1-0.1)/5/0.0
Na	----	0.04(0.0-0.1)/5/0.05	0.04(0.0-0.1)/5/0.05	0.04(0.0-0.1)/5/0.05
CEC	----	4.4(1.9-5.4)/5/2.3	5.0(1.7-9.1)/5/3.5	3.3(1.7-3.9)/5/1.3
ESP	----	----	----	----
% Base Sat.	----	51(14-100)/5/31	36(20-60)/5/17	27(4-53)/5/22

* Reported as Mean (Range)/N/Standard Deviation

Table 13
SUMMARY OF KEY SOIL PROPERTIES OF RUTH LAKE SOILS

	Horizon			
	Ae	Bm	BC	Ck
pH	7.2(---)/1/0.0*	6.0(5.1-6.7)/3/0.8	6.6(6.3-6.9)/2/0.4	7.7(---)/1/0.0
EC (mS/cm)	0.3(---)/1/0.0	----	----	0.4(---)/1/0.0
Org. C (kg/ha)	14(---)/1/0.0	----	----	----
Total N (kg/ha)	0.8(---)/1/0.0	----	----	----
C:N	17(---)1/0	----	----	----
Exchangeable Cations (meq/100g)				
Ca	----	3.1(---)/1/0.0	11.5(---)/1/0.0	31.4(---)/1/0.0
Mg	----	0.6(---)/1/0.0	0.6(---)/1/0.0	0.7(---)/1/0.0
K	----	0.2(---)/1/0.0	0.2(---)/1/0.0	0.1(---)/1/0.0
Na	----	0.0(---)/1/0.0	0.0(---)/1/0.0	0.1(---)/1/0.0
CEC	----	7.7(---)/1/0.0	9.1(---)/1/0.0	11.1(---)/1/0.0
ESP	----	0.0(---)/1/0.0	0.0(---)/1/0.0	0.9(---)/1/0.0
% Base Sat.	----	51(---)/1/0	100(---)/1/0	100(---)/1/0

* Reported as Mean (Range)/N/Standard Deviation

Soil Units: Only one Ruth Lake soil unit, RUT, was recognized. It includes dominantly Eluviated Eutric and Dystric Brunisols with inclusions (approximately 20%) of Orthic Eutric and Dystric Brunisols. Ruth Lake (RUT) only occurs in Lease 22 complexed with Mildred soils (MIL1), which are Eluviated Dystric Brunisols on sandy materials. The map unit is designated MIL1-RUT.

Soil Environment: Ruth soils are rapidly permeable and subhumid, meaning there can be significant moisture deficits during the growing season. The soils have low available water capacity and low cation exchange capacity due to the sandy textures. The frozen period extends from November to mid May and the soils warm fairly rapidly due to rapid permeability of air and water.

5.2.11 Miscellaneous Land Unit Descriptions

Beaver Dam (BD)

This symbol denotes areas flooded by beaver activity. Beaver dams are mapped by themselves, or complexed with small stream channels (BD-SC), or a poorly drained map unit such as an Algar 1 or Kenzie 3 soil unit (BD-ALG1-KNZ3). Soils are a complex of Gleysols with fluctuating amounts of inundation.

Disturbed Land (DL)

This symbol is used for areas where the surface soils have been removed or covered by industrial activity.

River Banks (RB)

The River Bank unit is used to denote the steep banks of the Dover and MacKay Rivers. Soil patterns consist of a complex of Orthic and Cumulic Regosols and bedrock outcrops, with considerable variability over short distances.

Stream Channel (SC)

The Stream Channel unit was used to denote the streams of the Dover and

MacKay Rivers. It was also used for the smaller creeks and includes undifferentiated components of the channel and small stream banks. Soils are complex mixtures of Gleysols and Regosols on a mixture of materials; with moisture regimes that are spatially and temporally variable. The variability prohibits differentiation, even at detailed mapping scales.

5.3 Summary of Soil Properties

The following section provides a summary of the soils by materials. Soil physical and chemical properties; moisture, temperature and nutrient regimes; and soil water properties are discussed.

5.3.1 Summary by Materials

Mineral soil materials are described in terms of origin (how they were deposited), and soil family particle size class. The organic (peat) soil materials are described in terms of genesis, composition, and stage of decomposition.

The correlation of soils by genetic materials is summarized in the "Key to Soil Taxonomic Classification" (Table 2) and is discussed in the "Soil Descriptions" (Section 5.2). Distribution of mineral soils by family particle size class is illustrated in Figure 3. Algar, Dover and Joslyn soils fall in the very fine clayey and fine clayey family particle size classes. Bitumount and Mildred soils are in the sandy family particle size class. McMurray soils, developed on recent fluvial sediments, have variable textures but are usually in the coarse loamy to fine silty classes. Ruth Lake soils have sandy textures overlying sandy-skeletal materials at variable depths.

Soils Developed on Sands: Soils developed on sands were identified as belonging to the Mildred, Ruth Lake and Bitumount soil series during the soil mapping process.

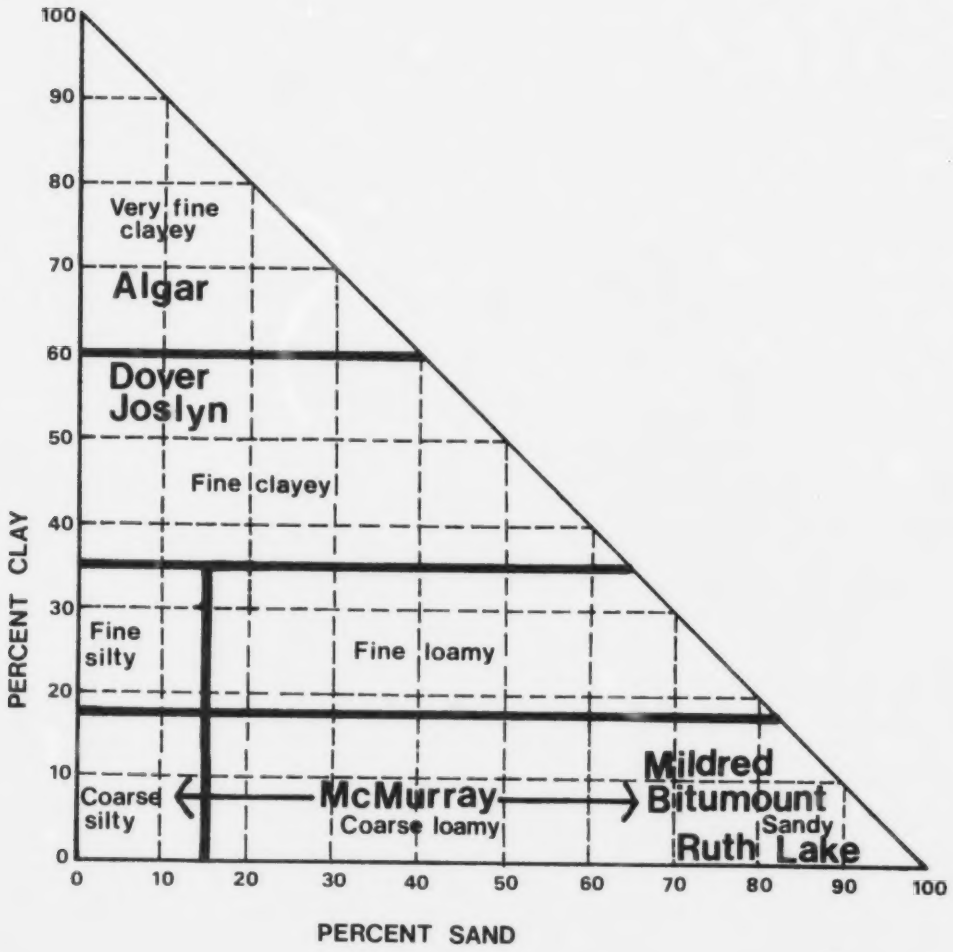


FIGURE 3 : DISTRIBUTION OF SOILS BY FAMILY TEXTURE CLASS

Textural classification of Mildred soils, by horizon, is shown diagramatically in Figure 3. Textures are dominantly loamy sands and sandy loams. The sands are fine to medium sized and developed from quartzites. Due to the coarse textures, the soils have rapid infiltration and permeability rates and low available water capacity. The sands are usually well sorted with very low content of fines.

The Ruth Lake soils are developed on sands which overlie gravelly sand and cobbly gravels 0.5 to 1.5 m below the surface. The sands may contain thin strata of loamy sediments and the gravels are discontinuous and variable in quality.

Bitumount soils occupy depressional areas in glaciofluvial landscapes. The materials are dominantly sands but layers of loamy or clayey sediments are common.

Soils Developed on Clayey and Fine Clayey Materials: Algar, Dover and Joslyn soils are developed on clayey materials.

Algar soils are poorly drained soils on clays, heavy clays, and silty clays of glaciolacustrine and recent lacustrine origin. Thin layers and lenses of loamy or sandy materials and occasionally buried peat layers occur in the soil profile. Due to the fine textures, massive structure and high bulk densities, the soils are very slowly permeable to water and air. Algar soils are frozen until mid summer.

Dover soils are freely drained Luvisolic soils developed on glaciolacustrine clays. The clays are gray to pinkish gray in color, plastic when moist, and sticky when wet. The clays infrequently overlie clay loam till at depths of less than 1.0 m.

Joslyn soils are developed on similar materials to the Dover soils. The soils are separated on a basis of profile development.

Soils Developed on Peats: Soils developed on peats are included in the Eaglesham, Kenzie and Mikkwa Soil Groups. Eaglesham soils are developed on fen peats, composed dominantly of sedges and Aulocomnium moss with minor amounts of Sphagnum moss. The stage of decomposition is variable but materials are usually in the mesic or humic class. Peat depths are variable and form the basis for separation of soil mapping units. The peat depth in EGL1 units is usually 0.6 - 1.2 cm and is usually in the order of 0.3 to 0.8 m in EGL2 units. Peats have bulk densities in the order of 0.1 to 0.3 (Table 14) and shrinkage values of 100 to 300 percent (Knapik and Westworth, 1982).

Kenzie soils are developed on bog peat, composed of mainly Sphagnum moss, and Ericaceous shrub leaves and stems. Bog peats tend to have higher wood content than fen peats and are more fibric. Bulk density values are in the order of 0.1 for fibric layers and 0.3 for mesic layers and shrinkage rates are in the order of 100 to 400 percent. Peat depth ranges are from 100 to 250 cm in KNZ1; 25 - 80 cm in KNZ2; and 40 - 120 cm in KNZ3 soil units.

Mikkwa soils are organic soils on bogs that are permanently frozen. Permafrost, in the form of clear ice lenses and frozen peat layers, occurs within 30 to 50 cm of the surface throughout the summer. The peat is mainly fibric, moss peat with high fibre content. Bulk densities are in the order of 0.1 to 0.3, and shrinkage rates are 100 to 300 percent (Knapik and Westworth, 1982). Peat depths are usually in the order of 2 to 3 metres.

5.3.2 Soils for Engineering Uses

Soils are used as structural materials and as foundations for structures. This section of the report is intended to provide information concerning the properties and limitations of soils of special significance to uses such as road construction and maintenance, foundations for small buildings, and shallow excavations. Estimated soil properties for soil groups are summarized in Table 15.

Table 14

SUMMARY OF BULK DENSITIES OF KEY SOILS

	Bulk Densities (g/cm3)
KNZ	
Of (10-30cm)	.18(.08-.28)/11/0.10*
Om-Of (30-40cm)	.34(.17-.50)/6/0.23
Om-Of (50-60cm)	.25(.10-.41)/4/0.22
ALL	.25(.08-.50)/21/0.16
MIL	
LF	.26(.05-.47)/2/0.29
Ae	1.34(1.11-1.59)/3/0.33
Bm	1.48(1.42-1.54)/3/0.08
DOV	
LF	0.24 (.19-.34)/7/.07
Ae	1.41(1.24-1.65)/6/.22
Bt	1.59(1.49-1.67)/6/.09

* Reported as: Mean(range)/N/Standard Deviation

Table 15
ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING USES

Soil Group	Depth (m) to Bedrock	Depth (m) to Seasonal Water Table	Material Description (Unified)	Value as Subrade	Shear Strength	Compressibility and Expansion	Compaction Characteristics	Comments
Algar	n.a.	surface	clays (CH-MH)	poor	low	high	fair to poor	ponded surface water in spring
Bitumount	n.a.	surface	sands (SM), some clayey layers	good to fair	medium	very slight to medium	good to fair	ponded surface water and seepage
Dover	n.a.	1	clays (CH)	poor	low	high	fair to poor	freely drained clays
Eaglesham	n.a.	surface	peat (pt)	not suitable	very low	very high	poor	"sedge bogs" very low trafficability
Joslyn	n.a.	1 - 3	clays (CH)	poor	low	high	fair to poor	very sticky, impermeable clays; seepage areas
Kenzie	n.a.	surface	peat (pt)	not suitable	very low	very high	poor	"muskeg" of variable depth
McMurray	2 - 10	surface	silts (ML-MH) and fine sands (SM)	fair to poor	medium to low	slight to medium	fair to poor	river terrace silts and sands; may flood
Mikkwa	permafrost 0.5 - 3	surface	peat (pt)	not suitable	very low	very high	poor	frozen muskeg
Mildred	n.a.	3 - 5	sands (SM-SC)	good	medium	slight	fair to good	well sorted medium sands
Ruth Lake	5 - 10	3 - 5	sand over gravelly, cobbly sands (GP)	good to excellent	high	very slight	good	fair to poor source of gravel

" Adapted from Knapik and Westworth, 1982.

The test data and predictions of soil performance reported must be considered as estimates of general soil properties, not as specific site test data. These estimates provide guidelines for planning and a basis for detailed soil investigations. On-site inspections are always required prior to development activities. Interpretations of soil properties are based on observations made in the field and related to published guidelines (U.S. Dept. of Agric., 1972). These observations are usually limited to a depth of 1.5 metres, but estimates of deeper materials can be made by applying knowledge of surficial geology and geomorphology.

Information contained on the soil map and legend should be used in conjunction with the written soil unit descriptions to obtain as much information as possible about delineated areas. The available information includes soil material characteristics, steepness of slopes, soil moisture conditions, water table depths, and depth of bedrock. Based on a knowledge of soil and land characteristics, it is possible to make good, though general, evaluations of soil unit suitability for such uses as road or pipeline location, or a source of sand or gravel. Evaluation of environmental sensitivity and estimates of construction and maintenance costs are aided by an understanding of terrain conditions.

5.3.3 Peat Resources

The peat resources of the area were evaluated to gain an understanding of location of deposits; depth and volume of materials; characteristics of the materials; and extent of permafrost in peatlands.

The locations of peat deposits, and information regarding depths, and quality can be obtained from the Soil Map, included in the back pocket, used in conjunction with Table 16 which relates peat depths to map units.

The total volume of peat on Lease 22 has been estimated from the inventory work at 66 million cubic metres. Individual peat deposits on the Lease are grouped into three depth categories (15 to 50 cm; 50 to 150 cm; and 150 to 300

Table 16

PEAT VOLUME SUMMARY BY SOIL MAP UNITS

Soil Map Unit	Hectares	Peat Volume ($\times 10^6 m^3$)	Depth Range of Peat (cm)
ALG1	549.6	1.169	15-50
ALG1-KNZ3	957.7	3.547	15-50
ALG2	343.9	1.342	15-50
BD	255.4	0	0
BD-ALG1-KNZ3	514.8	2.059	15-50
BD-SC	133.5	0	0
BMT1	83.2	0.154	15-50
BMT1-ALG1	42.4	0.212	15-50
BMT2	380.9	1.797	15-50
BMT2-ALG2	42.3	0.127	15-50
DL	758.2	0	0
DOV1	2241.5	0	0
DOV2	2792.0	0	0
DOV2-KNZ3	154.6	0.336	15-50
DOV2-MIL2	329.8	0	0
DOV3	221.2	0	0
EGL1	150.7	1.055	50-150
EGL2	278.9	1.397	50-150
JSN1	411.7	0	0
JSN2	163.5	0	0
KNZ1	1230.1	19.057	150-250
KNZ1-MKW	919.2	14.707	150-250
KNZ2	1201.7	6.292	50-150
KNZ2-MIL2	255.8	1.115	50-250
KNZ3	1333.7	8.872	50-150
KNZ3-EGL2	259.8	2.277	50-150
MMY1	91.4	0	0
MMY2	879.2	0.074	15-50
MIL1	697.1	0	0
MIL1-KNZ3	67.1	0.080	15-50
MIL1-RUT	406.7	0	0
MIL2	389.3	0	0
RB	854.5	0	0
SC	227.7	0	0
SC-EGL2	60.9	0.304	50-150
TOTAL	19,680	66.0	

cm) for volume calculations (Table 17). Volumes of peat on specific sites on the Lease can be calculated by overlying areas of interest on the Soil Map. The depth information is intended as a rough estimate of average depths over large areas, and may vary considerably within each area.

As noted in Table 17, approximately 51 percent of the total peat volume occurs as deposits within the thickness range of 150 to 250 cm. Approximately 32 and 17 percent of the total volume are in the 50 to 150 cm and 15 to 50 cm thickness ranges respectively.

5.3.4 Soil Water Relationships

Soil water relationships have been evaluated in terms of natural soil moisture regimes, and by estimation of moisture-tension values of disturbed samples. A correlation of soil drainage class, soil moisture subclass, ecological moisture regime, and available water capacity in the upper metre for each soil unit is presented in Table 18.

Availability of water to plants depends not only on size of the reservoir but also on flows into it by precipitation, capillary rise and lateral flow, and losses by percolation and evapotranspiration.

The ecological moisture regime (hygrotope) and nutrient regime (trophotope) of each soil unit (modal concept) are presented in grid form in Figure 4. It must be recognized that moisture and nutrient regimes can have wide variation within a soil unit due to site variability. The values listed in the tables and graphs are to be considered as modal values for entities defined as having a range of properties.

The Gleysolic and Organic soils have water table levels at the surface or within capillary reach of the surface for most of the growing season. The freely drained sandy soils (Mildred and Ruth Lake) rely on distribution of precipitation to satisfy plant requirements, and buffer against droughty

Table 17

SUMMARY OF PEAT THICKNESS AND VOLUMES

Deposit Thickness Range	Peat Volume Lease 22 ($\times 10^6 m^3$)	% of Total Peat Volume
0-15 cm	----	--
15-50 cm	10.90	17
50-150 cm	21.30	32
150-250 cm	33.80	51
TOTAL	66.00	100

Table 18

COMPARISON OF DRAINAGE CLASS, SOIL MOISTURE SUBCLASS, ECOLOGICAL MOISTURE REGIME AND AVAILABLE WATER CAPACITY BY SOIL UNIT

Soil Unit	Soil Drainage Class	Soil Moisture Subclass	Ecological Moisture Regime*	Available Water Cap. (cm in top 1m)
ALG	poorly	peraquic	subhygric	25
BMT	poorly	peraquic	subhygric	nd**
DOV	moderately well	perhumid	mesic	nd
EGL	very poorly	peraquic	hydric	nd
JSN	moderately well	humid	mesic	21
KNZ	very poorly	peraquic	subhydric	nd
MIL	rapidly	semiarid	subxeric - xeric	nd
MKW	very poorly	peraquic	subhydric	nd
MMY1	imperfectly	subaquic	subhygric	nd
MMY2	poorly	aquic	hydric	nd
RUT	rapidly	subhumid	subxeric	nd
RB	rapidly	variable	xeric	nd
SC	very poorly - poorly	variable	hydric - subhygric	nd

* See British Columbia Resource Analysis Branch (1980) for definitions.
** nd = no data.

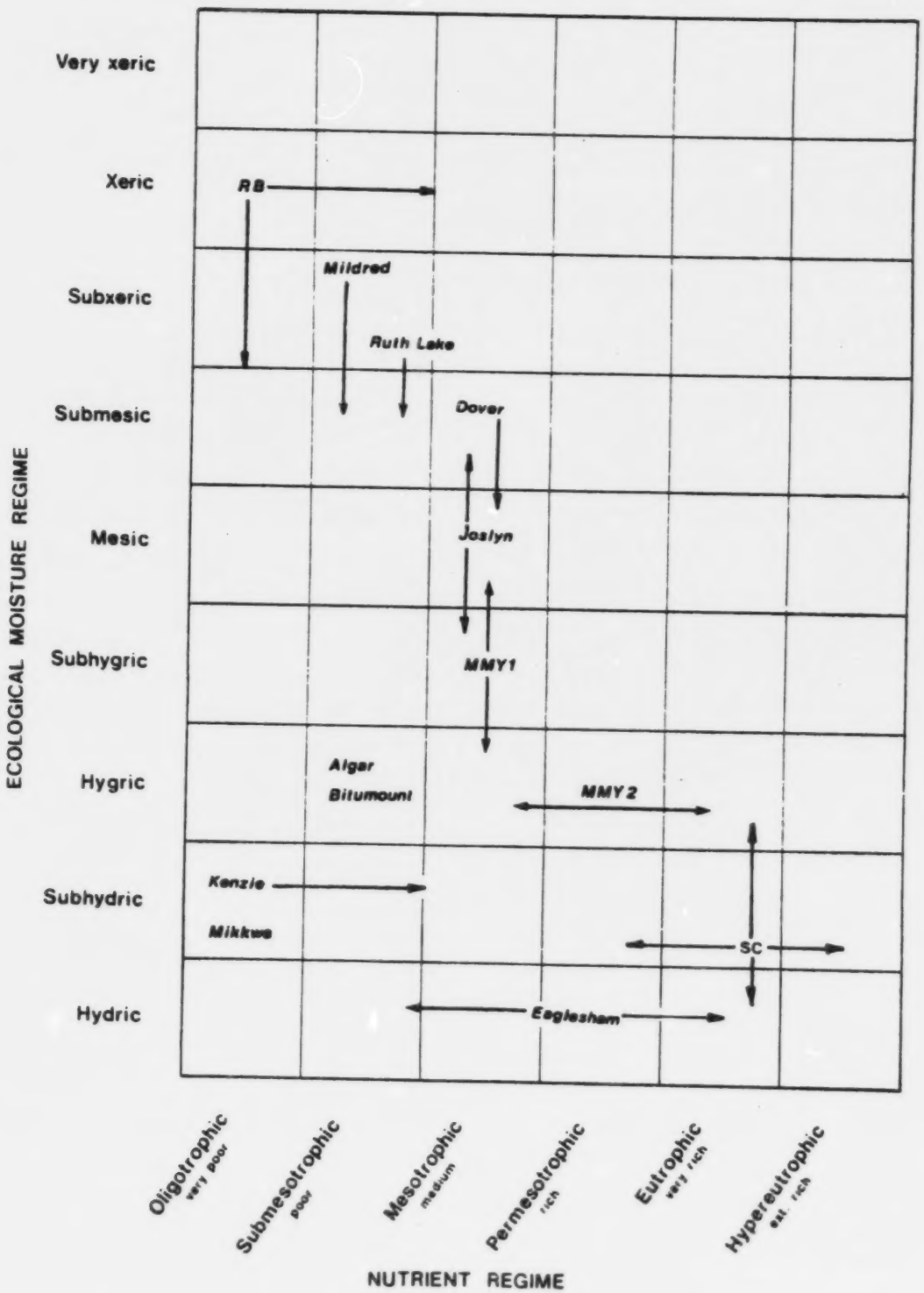


FIGURE 4: RELATIONSHIPS OF SOIL UNITS TO ECOLOGICAL MOISTURE REGIME AND NUTRIENT REGIME.

periods due to low available water capacity (AWC). These soils have a very low AWC - in the order of 5 cm, in an area with a calculated growing season deficit of 18 cm.

Dover soils have mesic moisture regimes due to good surface drainage and high AWC. Joslyn soils are mesic to subhygric due to ponded runoff waters and seasonally high water tables due to seepage. Moisture regimes of McMurray soils vary depending on site position and stream levels. The MMY2 Soil Unit is wetter and flooded more frequently than the MMY1 Soil Unit.

5.3.5 Soil Temperatures

Soil temperature affects plant distribution and growth by direct effects on physiological processes and indirectly by controlling microbiological activity and chemical reactions. Soil temperatures are strongly influenced by soil moisture (Figure 5), soil texture, and permeability rates. Poorly drained soils thaw later in the spring and warm very slowly in comparison to well drained soils. Peat layers insulate the underlying soils resulting in delayed thaw and the common occurrence of permafrost. Clay soils warm more slowly than sandy soils. Perennially frozen poorly drained clay soils have been identified 30 km north of this area (Knapik and Westworth, 1982).

Mikkwa soils are frozen throughout the year (Figure 6). Algar, Bitumount, Eaglesham, and Kenzie soils have a short unfrozen period, which correlates with poor drainage and peat surface layers. The freely drained, sandy soils (Mildred and Ruth Lake) have the longest unfrozen period.

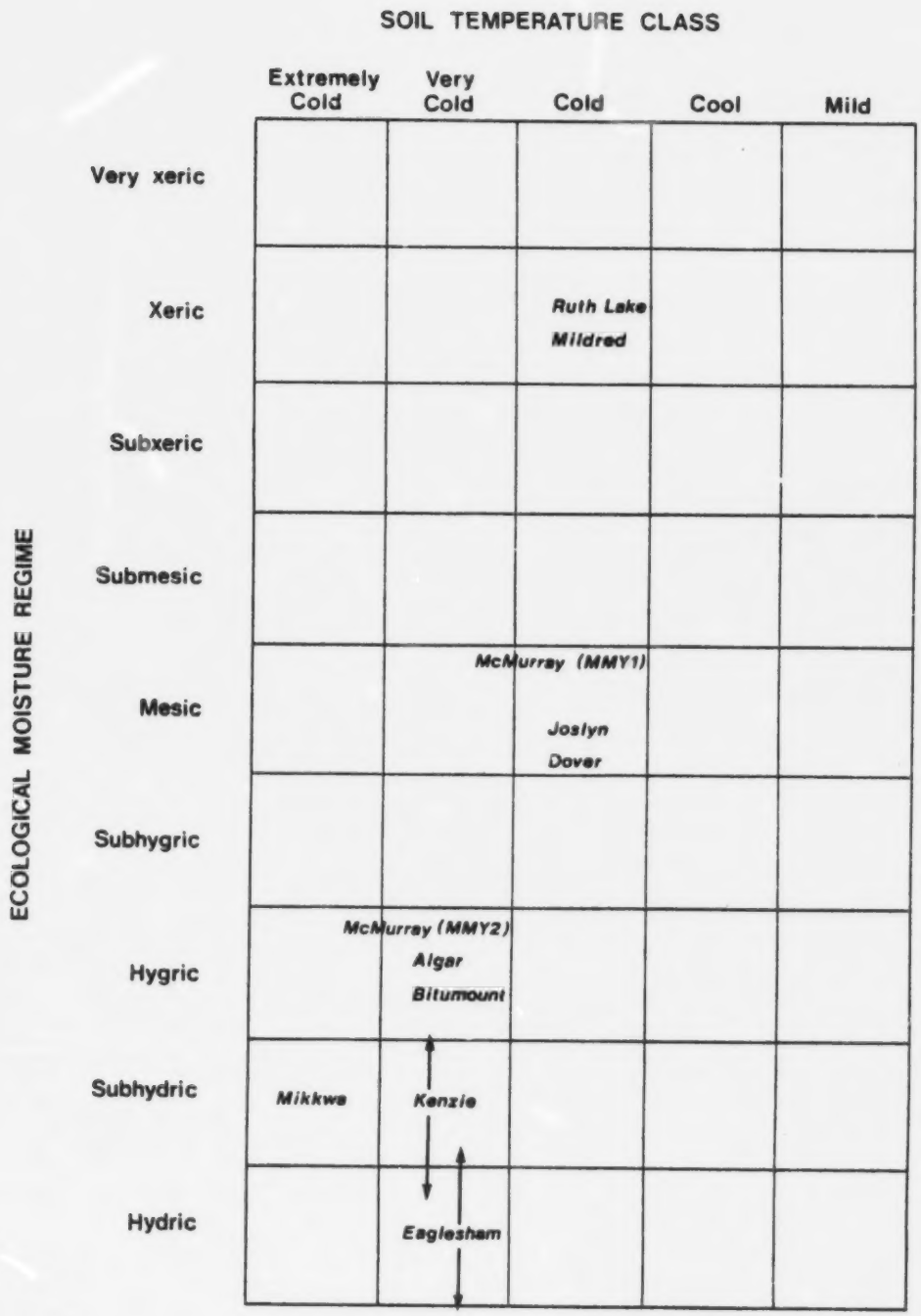


FIGURE 5: RELATIONSHIP OF SOILS TO TEMPERATURE CLASS AND MOISTURE REGIME.

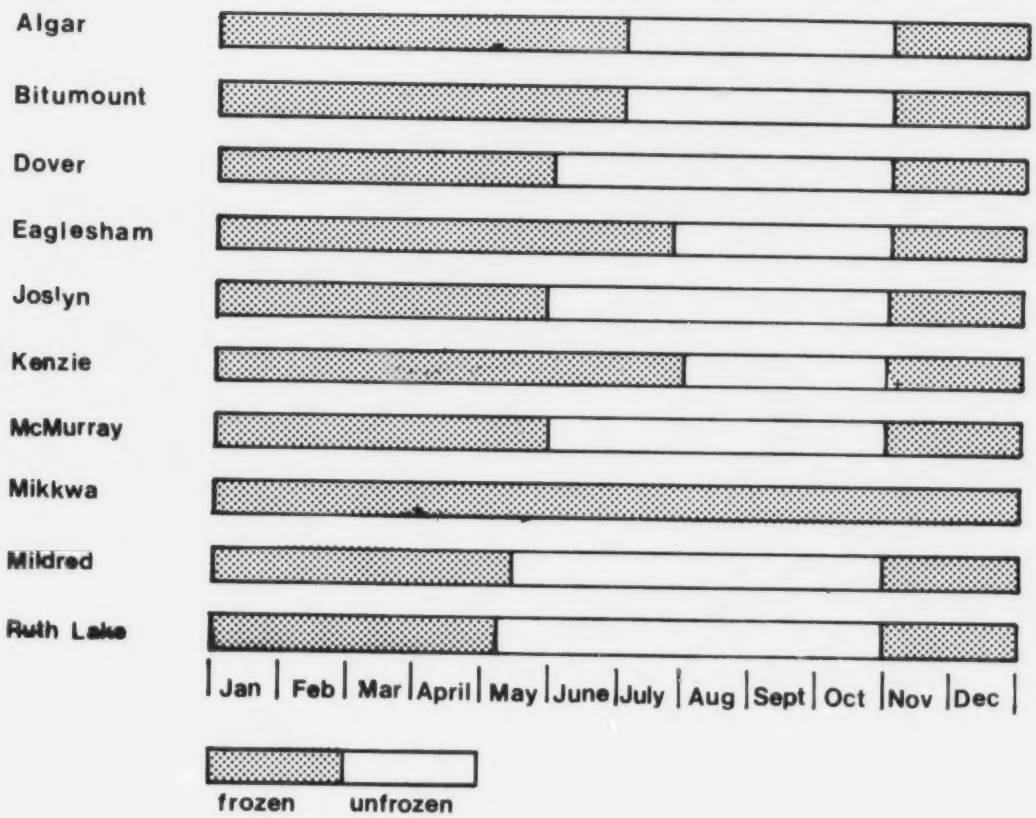


FIGURE 6 : DIAGRAMMATIC REPRESENTATION OF FROZEN - UNFROZEN PERIODS OF SOILS

6.0 REFERENCES

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Plate 1. Lease 22 is characterized by extensive peatlands and numerous beaver dams. The incised valleys of the MacKay and Dover Rivers provide the only significant relief for drainage.

Plate 2. Access to the majority of Lease 22 is very limited. Soil mapping and sampling was facilitated by the use of ATV's and helicopter support.

Plate 3. The soil landscape of Lease 22 is dominated by Organic soils on fairly thin peat blankets under bog or fen-bog vegetation. On better drained undulations the clayey Luvisolic soils usually support aspen forest.

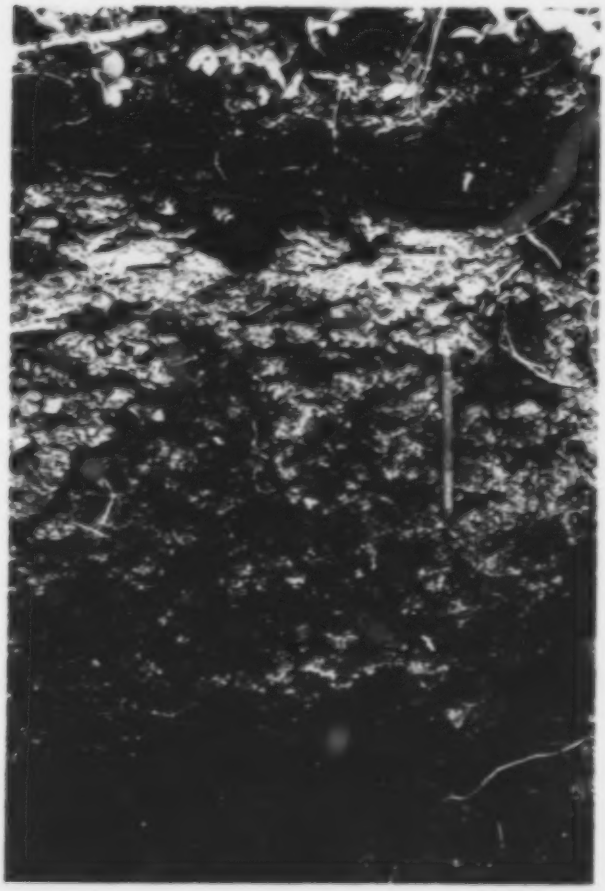

Plate 4. Dover soils are Orthic Gray Luvisols developed on glaciolacustrine clays and silty clays. This profile shows the distinct gleying of the DOV2 unit (Gleyed Gray Luvisol).

Plate 5. Eaglesham soils occur on fens with sedge-willow-bog birch-moss vegetation.

Plate 6. Mounded bogs are typical of frozen peat soils of the Mikkwa soil series.

Plate 7. Mildred soils are Eluviated Dystric Brunisols developed on sandy glaciofluvial sediments.

APPENDIX A

CORRELATION OF SOIL UNITS

CORRELATION OF SOIL UNITS
WITH AOSERP AND SYNCRUDE LEASE 17

Syncrude Lease 22	AOSERP*	Syncrude Lease 17**
ALG1	ALG1	MRL/P
ALG2	---	---
BMT1	BMT1	GUN/P
BMT2	---	---
DOV1	DOV1	MMY
DOV2	---	---
DOV3	---	---
EGL1	EGL1	---
EGL2	---	EGL1 & EGL2
---	---	EGL3
JSN1	JSN1	---
JSN2	---	---
KNZ1	KNZ1	KNZ3
KNZ2	---	---
KNZ3	KNZ2	KNZ1 & KNZ2
---	---	LDG
MIL1	MIL1	BKM1 & BKM2
MIL2	MIL2	---
MKW	MKW1 & MKW2	---
MMY1	MMY1	---
MMY2	MMY2	---
RUT	RUT1	MIL/S

* Turchenek and Lindsay. 1982. [These soil names are registered in the Alberta Names File (unpub.)]

** Twardy. 1978.

APPENDIX B

PROFILE DESCRIPTIONS

PROFILE AND ANALYTICAL DATA - Soil Series: Algar

Location: Site 1192; 48400E, 326500N Soil Map Unit: KNZ2 Classification: peaty Rego Gleysol

PROFILE DESCRIPTION

Horizon	Depth (cm)	Color	Field Texture	Structure	Consistence
Om	0-30	---	---	---	---
Cg	30-45	10YR5/4	vfSL-L	massive	sl. sticky
Cg	45-65	7.5YR4/2	CL	massive	sticky
Cg	65-100	7.5YR4/2	C	massive	sticky

Material: glaciolacustrine Topography: 1 Drainage: poorly Stoniness: SO

ANALYTICAL DATA

Horizon	Depth (cm)	pH	EC (mS/cm)	Total C (kg/ha)	Total N (kg/ha)	C:N	Exchangeable Cations (meq/100g) Ca	Mg	K	Na	CEC	Base Sat.	ESP	%CaCO3 Equiv.	Ash
Om	5-20	6.0	---	352	---	---	37.3	14.0	0.5	0.5	70.0	75	0.7	---	---
Cg	30-45	5.9	---	---	---	---	4.3	2.1	0.1	0.1	7.9	84	1.3	---	---
Cg	45-65	6.0	----	---	---	---	7.7	4.3	0.2	0.2	13.3	93	1.5	---	---
Cg	65-100	6.7	---	---	---	---	11.6	7.1	0.2	0.3	17.9	100	1.7	---	---

Horizon	Depth (cm)	Particle Size Analysis %S	%Si	%C	Texture	% Fiber Unrubbed	% Fiber Rubbed	Db (g/cm3)	Pyro. Index
Om	5-20	---	---	---	---	81	47	.06	---
Cg	30-45	35	43	22	L	---	---	---	---
Cg	45-65	41	23	36	CL	---	---	---	---
Cg	65-100	27	25	48	C	---	---	---	---

PROFILE AND ANALYTICAL DATA - Soil Series: Bitumount

Location: Site 1116; 36200E, 33088N Soil Map Unit: BMT2 Classification: peaty Rego Gleysol

PROFILE DESCRIPTION

Horizon	Depth (cm)	Color	Field Texture	Structure	Consistence
Of	0-20	---	---	---	---
Oh	20-35	---	---	---	---
Cg	35-100	10YR5/4	S-LS	single grain	massive

Material: glaciofluvial Topography: 2 Drainage: poorly Stoniness: SO

ANALYTICAL DATA

Horizon	Depth (cm)	pH	EC (mS/cm)	Total C (kg/ha)	Total N (kg/ha)	C:N	Exchangeable Cations (meq/100g) Ca	Mg	K	Na	CEC	Base Sat.	ESP	%CaCO3 Equiv.	Ash

Horizon	Depth (cm)	Particle Size Analysis %S	%Si	%C	Texture	% Fiber Unrubbed	% Fiber Rubbed	Db (g/cm3)	Pyro. Index

PROFILE AND ANALYTICAL DATA - Soil Series: Dover

Location: Site 1317; 470000E, 337400N Soil Map Unit: DOV1 Classification: Orthic Gray Luvisol

PROFILE DESCRIPTION

Horizon	Depth (cm)	Color	Field Texture	Structure	Consistence
LH	12-0	---	---	---	---
Ae	0-15	10YR5/2	SL-L	weak medium platy	friable
AB	15-18	7.5YR4/3	CL-C	weak medium subangular blocky	friable
Bt	18-45	7.5YR4/3	C	strong medium subangular blocky	firm
BC	45-100	7.5YR4/3	C	massive	firm

Material: glaciolacustrine Topography: 2 Drainage: moderately well Stoniness: S0

ANALYTICAL DATA

Horizon	Depth (cm)	pH	EC (mS/cm)	Total C (kg/ha)	Total N (kg/ha)	C:N	Exchangeable Cations (meq/100g) Ca	Mg	K	Na	CEC	Base Sat.	ESP	%CaCO3 Equiv.	Ash
Ae	0-10	6.0	---	16	2.5	7	2.2	0.1	0.1	0.0	5.2	46	0.0	---	---
Bt	20-40	4.7	---	---	---	---	8.5	4.1	0.3	0.1	23.1	56	0.4	---	---
BC	50-75	4.7	---	---	---	---	8.8	4.3	0.3	0.2	22.6	60	0.8	---	---

Horizon	Depth (cm)	Particle Size Analysis %S	%Si	%C	Texture	% Fiber Unrubbed	% Fiber Rubbed	Db (g/cm3)	Pyro. Index
Ae	0-10	43	48	9	L	---	---	---	---
Bt	20-40	19	16	65	C	---	---	---	---
BC	50-75	23	16	61	C	---	---	---	---

PROFILE AND ANALYTICAL DATA - Soil Series: Dover (2)

Location: Site 1479; 529000E, 329300N Soil Map Unit: DOV2 Classification: Gleyed Gray Luvisol

PROFILE DESCRIPTION

Horizon	Depth (cm)	Color	Field Texture	Structure	Consistence
LFH	6-0	---	---	---	---
Aegj	0-6	10YR6/3	SiL	weak medium platy	friable
AB	6-10	10YR5/3	SiCL	moderate fine subangular blocky	firm
Btgj	10-40	5YR5/2	C	strong medium prismatic	firm
BC	40-70	5YR4/1	C	massive	firm
Ckgj	70-110	10YR5/3	C	massive	firm

Material: glaciolacustrine Topography: 2 Drainage: imperfectly Stoniness: S0

ANALYTICAL DATA

Horizon	Depth (cm)	pH	EC (mS/cm)	Total C (kg/ha)	Total N (kg/ha)	C:N	Exchangeable Cations (meq/100g) Ca	Mg	K	Na	CEC	Base Sat.	ESP	%CaCO3 Equiv.	Ash
LFH	6-0	5.6	---	24	---	---	13.6	5.4	0.6	0.1	27.3	72	0.4	---	---
Aegj	0-6	5.4	---	7.7	0.4	18	3.2	1.9	0.2	0.0	7.2	73	0.0	---	---
Btgj	20-30	5.1	---	---	---	---	8.2	12.0	0.5	0.2	23.3	90	0.9		
BC	40-70	7.0	---	---	---	---	10.6	12.7	0.3	0.5	22.9	100	2.2	---	---
Ckgj	70-110	7.9	1.0	---	---	---	28.1	9.8	0.2	1.1	13.5	100	8.1	7.3	---

Horizon	Depth (cm)	Particle Size Analysis %S	%Si	%C	Texture	% Fiber Unrubbed	% Fiber Rubbed	Db (g/cm3)	Pyro. Index
LFH	6-0	---	---	---	---	---	---	---	---
Aegj	0-6	34	53	13	SiL	---	---	0.2	---
Btgj	20-30	19	29	52	C	---	---	1.3	---
BC	40-70	20	29	51	C	---	---	1.6	---
Ck	70-110	22	33	45	C	---	---	---	---

PROFILE AND ANALYTICAL DATA - Soil Series: Dover (3)

Location: Site 1461; 535000E, 337400N Soil Map Unit: DOV3 Classification: Orthic Gray Luvisol

PROFILE DESCRIPTION

Horizon	Depth (cm)	Color	Field Texture	Structure	Consistence
LFH	6-0	---	---	---	---
Ae	0-8	10YR6/2	fSL	moderate medium platy	friable
AB	8-14	7.5YR5/4	fSCL	moderate medium subangular blocky	firm
Bnt	14-40	7.5YR5/4	C	strong medium subangular blocky	firm
BC	40-75	5YR5/3	C	massive	firm
IIBC	75-90	10YR4/2	CL-C	massive	firm

Material: glaciolacustrine/moraine Topography: 3 Drainage: moderately well Stoniness: S0

ANALYTICAL DATA

Horizon	Depth (cm)	pH	EC (mS/cm)	Total C (kg/ha)	Total N (kg/ha)	C:N	Exchangeable Cations (meq/100g) Ca	Mg	K	Na	CEC	Base Sat.	ESP	%CaCO3 Equiv.	Ash
Ae	0-8	6.0	---	8.2	0.5	18	2.6	0.7	0.1	0.0	4.8	70	0.0	---	---
Bt	15-40	4.8	---	---	---	---	7.1	4.7	0.2	0.1	15.3	79	0.7	---	---
BC	40-75	5.0	---	---	---	---	10.8	7.2	0.3	0.2	23.1	80	0.9	---	---
IIBC	75-90	7.5	0.3	---	---	---	16.8	6.0	0.2	0.2	14.9	100	1.3	3.2	---

Horizon	Depth (cm)	Particle Size Analysis %S	%Si	%C	Texture	% Fiber Unrubbed	% Fiber Rubbed	Db (g/cm3)	Pyro. Index
Ae	0-8	54	37	9	SL	---	---	---	---
Bt	15-40	26	23	51	C	---	---	---	---
BC	40-75	20	17	63	C	---	---	---	---
IIBC	75-90	31	26	43	C	---	---	---	---

PROFILE AND ANALYTICAL DATA - Soil Series: Eaglesham

Location: Site 1290; 539000E, 334600N Soil Map Unit: KNZ2 Classification: Terric Mesisol

PROFILE DESCRIPTION

Horizon	Depth (cm)	Color	Field Texture	Structure	Consistence
Om	0-70	---	---	---	---
Cg	70-100	10YR5/1	SiCL-CL	massive	sticky

Material: mesic sedge & moss peat/glaciolacustrine Topography: 2 Drainage: very poorly Stoniness: 50

ANALYTICAL DATA

Horizon	Depth (cm)	pH	EC (mS/cm)	Total C (kg/ha)	Total N (kg/ha)	C:N	Exchangeable Cations (meq/100g) Ca	Mg	K	Na	CEC	Base Sat.	ESP	%CaCO3 Equiv.	Ash
Om	10-30	6.1	---	229	7.9	29	48.0	20.5	0.3	0.6	71.7	97	0.3	---	13.1
Om	30-70	6.1	---	426	16.0	27	55.5	21.3	0.2	0.7	77.7	100	0.9	14.6	
Cg	70-100	6.2	---	---	---	---	10.0	4.9	0.1	0.2	15.7	97	1.3	---	---

Horizon	Depth (cm)	Particle Size Analysis %S	%Si	%C	Texture	% Fiber Unrubbed	% Fiber Rubbed	Db (g/cm3)	Pyro. Index
Om	10-30	---	---	---	---	80	50	---	- 1
Om	30-70	---	---	---	---	74	38	---	- 1
Cg	70-100	43	24	33	CL	---	---	---	---

PROFILE AND ANALYTICAL DATA - Soil Series: Joselyn (1)

Location: Site 1079; 44500E, 33470ON Soil Map Unit: ALG1-KNZ3 Classification: Gray Solodized Solonetz

PROFILE DESCRIPTION

Horizon	Depth (cm)	Color	Field Texture	Structure	Consistence
LH	8-0	---	---	---	---
Ae	0-15	7.5YR7/2	fSL	weak medium platy	friable
Bnt	15-50	7.5YR5/4	C	strong coarse columnar and strong coarse subangular blocky	firm
Csk	50-75	7.5YR4/3	SiCL	massive	firm
IICk	75-100	10YR4/3	SiCL	massive	firm

Material: glaciolacustrine (2 kinds) Topography: 3 Drainage: well Stoniness: 50

ANALYTICAL DATA

Horizon	Depth (cm)	pH	EC (mS/cm)	Total C (kg/ha)	Total N (kg/ha)	C:N	Exchangeable Cations (meq/100g) Ca	Mg	K	Na	CEC	Base Sat.	ESP	%CaCO3 Equiv.	Ash
Ae	0-15	5.6	---	15	0.8	17	---	---	---	---	---	---	---	---	---
Bnt	15-30	4.7	---	---	---	---	---	---	---	---	---	---	---	---	---
Csk	50-75	7.1	---	---	---	---	---	---	---	---	---	---	---	---	---
IICk	75-100	8.3	1.2	---	---	---	---	---	---	---	---	---	---	13.6	---
														---	---

Horizon	Depth (cm)	Particle Size Analysis %S	%Si	%C	Texture	% Fiber Unrubbed	% Fiber Rubbed	Db (g/cm3)	Pyro. Index

PROFILE AND ANALYTICAL DATA - Soil Series: Joselyn (2)

Location: Site 1327; 560000E, 333000N Soil Map Unit: DOV2 Classification: Gleyed Gray Solod

PROFILE DESCRIPTION

Horizon	Depth (cm)	Color	Field Texture	Structure	Consistence
LFH	5-0	---	---	---	---
Aegj	0-12	10YR5/2	SiCL-SiL	strong medium platy	friable
AB	12-20	10YR5/2	SiCL	moderate medium subangular blocky	firm
Bntgj	20-50	7.5YR5/2	C	strong coarse subangular blocky	firm
Ck	50-100	10YR5/3	C	massive	firm

Material: glaciolacustrine Topography: 3 Drainage: imperfectly Stoniness: SO

ANALYTICAL DATA

Horizon	Depth (cm)	pH	EC (mS/cm)	Total C (kg/ha)	Total N (kg/ha)	C:N	Exchangeable Cations (meq/100g) Ca	Mg	K	Na	CEC	Base Sat.	ESP	%CaCO3 Equiv.	Ash
Aegj	0-10	5.5	---	42	3.4	12	2.4	1.5	0.1	0.2	8.8	48	2.3	---	---
Bntgj	25-40	6.6	---	---	---	---	8.6	6.2	0.2	1.7	18.5	90	91.2	---	---
Ck	50-75	8.1	0.8	---	---	---	33.3	6.7	0.2	3.4	17.3	100	19.7	6.8	---
Ck	80-100	8.3	0.9	---	---	---	26.3	6.7	0.3	3.6	17.3	100	20.8	7.3	---

Horizon	Depth (cm)	Particle Size Analysis %S	%Si	%C	Texture	% Fiber Unrubbed	% Fiber Rubbed	Db (g/cm3)	Pyro. Index
Aegj	0-10	22	55	23	SiL	---	---	---	---
Bntgj	25-40	21	38	41	C	---	---	---	---
Ck	50-75	13	35	52	C	---	---	---	---
Ck	80-100	10	35	55	C	---	---	---	---

PROFILE AND ANALYTICAL DATA - Soil Series: Kenzie (1)

Location: Site 1099; 44800E, 331200N Soil Map Unit: KNZ1 Classification: Typic Mesisol

PROFILE DESCRIPTION

Horizon	Depth (cm)	Color	Field Texture	Structure	Consistence
Of	0-30	---	---	---	---
Om	30-75	---	---	---	---
Om	75-220	---	---	---	---

Material: mesic sphagnum peat Topography: 2 Drainage: very poorly Stoniness: SO

ANALYTICAL DATA

Horizon	Depth (cm)	pH	EC (mS/cm)	Total C (kg/ha)	Total N (kg/ha)	C:N	Exchangeable Cations (meq/100g) Ca	Mg	K	Na	CEC	Base Sat.	ESP	%CaCO3 Equiv.	Ash
Of	0-30	3.6	---	341	4.2	81	3.0	1.4	0.3	0.1	22.2	22	0.5	---	3.9
Om	30-75	3.9	---	577	10.0	59	7.9	2.9	0.1	0.3	59.4	19	0.5	---	4.2
Om	75-120	3.8	---	554	7.2	77	11.8	3.7	0.1	0.3	64.6	25	0.5	---	4.1
Om	120-210	4.4	---	218	25.0	9	23.5	5.0	0.1	0.3	63.7	45	0.5	---	5.7

Horizon	Depth (cm)	Particle Size Analysis %S	%Si	%C	Texture	% Fiber Unrubbed	% Fiber Rubbed	Db (g/cm3)	Pyro. Index
Of	0-30	---	---	---	---	92	82	---	6
Om	30-75	---	---	---	---	74	50	---	1
Om	75-120	---	---	---	---	92	76	---	3
Om	120-210	---	---	---	---	84	72	---	4

PROFILE AND ANALYTICAL DATA - Soil Series: Kenzie

Location: Site 0081; 486000E, 329400N Soil Map Unit: KNZ2 Classification: Terric Fibrisol

PROFILE DESCRIPTION

Horizon	Depth (cm)	Color	Field Texture	Structure	Consistence
Of1	0-30	10YR4/4	---	---	---
Of2	30-60	10YR4/3	---	---	---
Ofz	60-90	10YR4/2	---	---	---
Of3	90-100	10YR4/3	---	---	---
Cg	100-120	2.5YR4/2	C	massive	sticky

Material: fibric sphagnum peat/glaciolacustrine Topography: 1 Drainage: very poorly Stoniness: 50

ANALYTICAL DATA

Horizon	Depth (cm)	pH	EC (mS/cm)	Total C (kg/ha)	Total N (kg/ha)	C:N	Exchangeable Cations (meq/100g) Ca	Mg	K	Na	CEC	Base Sat.	ESP	%CaCO3 Equiv.	Ash
Of1	0-30	3.9	---	368	6.5	56	12.3	5.2	0.3	1.1	63.1	30	1.7	---	5.3
Of2	30-60	4.1	---	347	5.0	69	17.7	6.5	0.1	0.9	55.7	45	1.6	---	5.7
Ofz	60-90	4.6	---	355	5.9	60	33.8	7.6	0.1	0.6	74.9	56	0.8	---	7.4
Cg	100-120	5.7	---	---	---	---	15.3	5.5	0.3	0.2	20.3	100	1.0	---	---

Horizon	Depth (cm)	Particle Size Analysis %S	%Si	%C	Texture	% Fiber Unrubbed	% Fiber Rubbed	Db (g/cm3)	Pyro. Index
Of1	0-30	---	---	---	---	68	46	---	3
Of2	30-60	---	---	---	---	92	62	---	4
Ofz	60-90	---	---	---	---	88	70	---	3
Cg	100-120	16	23	61	C	---	---	---	---

PROFILE AND ANALYTICAL DATA - Soil Series: Kenzie

Location: Site 1341; 56200E, 334000N Soil Map Unit: KNZ3 Classification: Terric Mesisol

PROFILE DESCRIPTION

Horizon	Depth (cm)	Color	Field Texture	Structure	Consistence
Om	0-50	---	---	---	---
Cg1	50-110	10YR5/3	C-CL	massive	sticky
Cg2	110-130	7.5YR5/3	SiC-C	massive	sticky

Material: mesic sphagnum peat/glaciolacustrine Topography: 1 Drainage: very poorly Stoniness: SO

ANALYTICAL DATA

Horizon	Depth (cm)	pH	EC (mS/cm)	Total C (kg/ha)	Total N (kg/ha)	C:N	Exchangeable Cations (meq/100g) Ca	Mg	K	Na	CEC	Base Sat.	ESP	%CaCO3 Equiv.	Ash
Om	0-25	6.4	---	309	11.0	29	50.0	18.5	0.5	0.7	74.0	94	0.9	---	11.7
Om	25-40	6.7	---	152	9.1	28	49.5	21.2	0.1	1.1	74.0	97	1.5	---	---
Cg1	50-75	7.2	0.3	---	---	---	8.5	5.0	0.2	0.6	10.5	100	5.7	---	---
Cg2	110-130	7.9	0.4	---	---	---	31.1	5.2	0.2	0.9	15.8	100	5.7	64	---

Horizon	Depth (cm)	Particle Size Analysis %S	%Si	%C	Texture	% Fiber Unrubbed	% Fiber Rubbed	Db (g/cm3)	Pyro. Index
Om	0-25	---	---	---	---	82	48	---	3
Om	25-40	---	---	---	---	76	44	---	2
Cg1	50-75	22	42	36	CL	---	---	---	---
Cg2	110-130	22	32	46	C	---	---	---	---

PROFILE AND ANALYTICAL DATA - Soil Series: Mildred

Location: Site 1112; 375000E, 330900N Soil Map Unit: MIL1 Classification: Eluviated Eutric Brunisol

PROFILE DESCRIPTION

Horizon	Depth (cm)	Color	Field Texture	Structure	Consistence
LH	4-0	---	---	---	---
Ae	0-5	10YR6/2	S	single grain	loose
Bm	5-60	10YR5/6	S	single grain	loose
BC	60-100	10YR6/4	S	single grain	loose

Material: glaciofluvial Topography: 3 Drainage: Stoniness:

ANALYTICAL DATA

Horizon	Depth (cm)	pH	EC (mS/cm)	Total C (kg/ha)	Total N (kg/ha)	C:N	Exchangeable Cations (meq/100g) Ca	Mg	K	Na	CEC	Base Sat.	ESP	%CaCO3 Equiv.	Ash
Ae	0-5	5.7	---	6.7	0.3	25	2.0	0.2	0.1	0.0	4.4	52	0.0	---	---
Bm	10-50	6.7	---	---	---	---	0.4	0.0	0.1	0.0	1.7	29	0.0	---	---
BC	60-100	6.3	---	---	---	---	0.4	0.0	0.1	0.0	2.4	20	0.0	---	---

Horizon	Depth (cm)	Particle Size Analysis %S	%Si	%C	Texture	% Fiber Unrubbed	% Fiber Rubbed	Db (g/cm3)	Pyro. Index
Ae	0-5	95	2	3	S	---	---	---	---
Bm	10-50	95	1	4	S	---	---	---	---
BC	60-100	95	1	4	S	---	---	---	---

PROFILE AND ANALYTICAL DATA - Soil Series: Mildred

Location: Site 1480; 385OOE 335400N Soil Map Unit: Classification: Eluviated Dystric Brunisol

PROFILE DESCRIPTION

Horizon	Depth (cm)	Color	Field Texture	Structure	Consistence
LFH	10-0	---	---	---	---
Ae	0-10	7.5YR7/2	S	single grain	loose
Bm	10-40	10YR5/6	S	single grain	loose
BC	40-100	10YR5/6	S	single grain	loose

Material: glaciofluvial Topography: 3 Drainage: rapidly Stoniness: SO

ANALYTICAL DATA

Horizon	Depth (cm)	pH	EC (mS/cm)	Total C (kg/ha)	Total N (kg/ha)	C:N	Exchangeable Cations (meq/100g) Ca	Mg	K	Na	CEC	Base Sat.	ESP	%CaCO3 Equiv.	Ash
LFH	6-0	5.1	---	110	---	---	---	---	---	---	---	---	---	---	---
Ae	0-10	4.7	---	7.5	0.5	14	---	---	---	---	---	---	---	---	---
Bm	12-19	5.0	---	---	---	---	---	---	---	---	---	---	---	---	---

Horizon	Depth (cm)	Particle Size Analysis %S	%Si	%C	Texture	% Fiber Unrubbed	% Fiber Rubbed	Db (g/cm3)	Pyro. Index
LFH	---	---	---	---	---	---	---	---	---
Ae	---	---	---	---	---	---	---	.05	---
Bm	---	---	---	---	---	---	---	1.1	---
								1.4	---

PROFILE AND ANALYTICAL DATA - Soil Series: Mikkwa

Location: Site 1088; 448OOE, 332800N Soil Map Unit: KNZ1-MKW Classification: Mesic Organic Cryosol

PROFILE DESCRIPTION

Horizon	Depth (cm)	Color	Field Texture	Structure	Consistence
Om1	0-30	---	---	---	---
Omz1	30-75	---	---	---	---
Om2	75-110	---	---	---	---
Omz2	110+	---	---	---	---

Material: mesic sphagnum peat Topography: 2 Drainage: very poorly Stoniness: SO

ANALYTICAL DATA

Horizon	Depth (cm)	pH	EC (mS/cm)	Total C (kg/ha)	Total N (kg/ha)	C:N	Exchangeable Cations (meq/100g) Ca	Mg	K	Na	CEC	Base Sat.	ESP	%CaCO3 Equiv.	Ash
Om1	0-30	3.5	---	384	4.6	80	2.6	1.2	0.2	0.1	35.1	14	---	---	2.9
Omz1	30-75	3.6	---	534	11	50	6.8	3.6	0.2	0.7	53.7	21	---	---	3.4
Om2	75-110	3.6	---	459	6.9	67	6.9	3.9	0.1	0.8	55.4	21	---	---	2.4

Horizon	Depth (cm)	Particle Size Analysis %S	%Si	%C	Texture	% Fiber Unrubbed	% Fiber Rubbed	Db (g/cm3)	Pyro. Index
Om1	0-30	---	---	---	---	76	68	---	4
Omz1	30-75	---	---	---	---	82	74	---	1
Om2	75-110	---	---	---	---	82	76	---	---

PROFILE AND ANALYTICAL DATA - Soil Series: Ruth Lake

Location: Site 1153; 393OOE, 336600N Soil Map Unit: MIL1-RUT Classification: Eluviated Eutric Brunisol

PROFILE DESCRIPTION

Horizon	Depth (cm)	Color	Field Texture	Structure	Consistence
LH	6-0	---	---	---	---
Ae	0-15	---	LS	weak medium platy	very friable
Bm	15-50	---	gvLS	weak medium subangular blocky	very friable

Material: glaciofluvial Topography: 6 Drainage: rapidly Stoniness: S1

ANALYTICAL DATA

Horizon	Depth (cm)	pH	EC (mS/cm)	Total C (kg/ha)	Total N (kg/ha)	C:N	Exchangeable Cations (meq/100g) Ca	Mg	K	Na	CEC	Base Sat.	ESP	%CaCO3 Equiv.	Ash
Ae	0-10	7.2	0.27	14	0.8	17	---	---	---	---	---	---	---	---	---
Bm	15-50	6.7	---	---	---	---	---	---	---	---	---	---	---	---	---

Horizon	Depth (cm)	Particle Size Analysis %S	%Si	%C	Texture	% Fiber Unrubbed	% Fiber Rubbed	Db (g/cm3)	Pyro. Index

PROFILE AND ANALYTICAL DATA - Soil Series: Ruth Lake

Location: Site 1127; 372000E, 334000N Soil Map Unit: MIL1-RUT Classification: Orthic Eutric Brunisol

PROFILE DESCRIPTION

Horizon	Depth (cm)	Color	Field Texture	Structure	Consistence
LH	5-0	---	---	---	---
Bm	0-30	5YR4/4	fSL	moderate medium subangular blocky	friable
BC	30-60	7.5YR4/4	fSL	massive	friable
Ck	60-70	7.5YR4/4	gvfSL	massive	friable

Material: glaciofluvial Topography: 5 Drainage: welldly Stoniness: S1

ANALYTICAL DATA

Horizon	Depth (cm)	pH	EC (mS/cm)	Total C (kg/ha)	Total N (kg/ha)	C:N	Exchangeable Cations (meq/100g) Ca	Mg	K	Na	CEC	Base Sat.	ESP	%CaCO3 Equiv.	Ash
Bm	0-30	5.1	---	---	---	---	3.1	0.6	0.2	0.0	7.7	51	0.0	---	---
BC	50-60	6.9	---	---	---	---	11.5	0.6	0.2	0.0	9.1	100	0.0	---	---
Ck	60-70	7.7	0.38	---	---	---	31.4	0.7	0.1	0.1	11.1	100	0.9	16.8	---

Horizon	Depth (cm)	Particle Size Analysis %S	%Si	%C	Texture	% Fiber Unrubbed	% Fiber Rubbed	Db (g/cm3)	Pyro. Index
Bm	0-30	53	37	10	SL	---	---	---	---
BC	50-60	59	25	16	SL	---	---	---	---
CL	60-70	53	31	16	SL	---	---	---	---

APPENDIX C

SUMMARY OF INSPECTION SITES

Site	Location		Soil Classification	Materials	Particle Size
	Easting	Northing			
0001	39700	332400	O.GL	GL	vf
0002	40500	332400	O.GL	M/GL	mf/f
0003	40700	333400	O.GL	GL	m/vf
0004	41200	333400	T.M	B/GL @ 60	vf
0005	41600	333600	TME.OC	B/GL @ 60	mf
0006	41700	333800	FI.OC	B	-
0007	42200	334200	TY.M	B/GL @ 240	vf
0008	42900	334500	FI.OC	B	-
0009	42900	334900	ME.OC	B	-
0010	43100	335000	T.M	B/GL @ 100	vf
0011	43700	335800	T.M	B/GL @ 80	vf
0012	43400	335800	O.G	GL	vf
0013	42700	335800	R.G	GF	vc
0014	42200	335800	ptR.G	GF/GL	mc/vf
0015	41900	335600	FI.OC	B	-
0016	41600	335600	ptO.G	GL	vf/f
0017	41300	335000	T.H	B/GL @ 40	f
0018	40900	334600	O.G	GL	m/vf
0019	40500	334500	O.GL	GL	f
0020	40100	333800	T.M	B/GL @ 70	vf
0021	39600	330500	E.DYB	GF	vc
0022	45100	336500	O.GL	GL	vf
0023	45200	337000	O.GL	GL	vf
0024	44800	337000	O.GL	GL	vf
0025	44200	337000	T.H	B/GL @ 60	vf
0026	44000	337000	ptO.G	GL	vf
0027	44300	337200	T.M	B/GL @ 90	vf
0028	45200	337400	O.GL	GF/GL	vf
0029	43600	329600	TY.F	B	-

Site	Location		Soil Classification	Materials	Particle Size
	Easting	Northing			
0030	43300	329600	TY.F	B	-
0031	43100	329800	ME.F	FN	-
0032	42400	329600	O.LG	GL	f
0033	42100	329600	T.M	B/GL @ 90	vf
0034	42500	329900	T.M	B/GL @ 90	f
0035	42300	330500	TFI.OC	B/GL @ 40	vf
0036	42500	331000	O.GL	GL	vf
0037	42400	331500	O.GL	GL	vf
0038	42400	331800	T.M	B/GL @ 70	vf
0039	42700	332400	O.GL	GL	vf
0040	42700	331900	T.M	F/GL @ 110	f
0041	43200	331300	T.M	B/GL @ 90	vf
0042	43500	331000	R.HG	GF/GL	mf/vf
0043	43600	330900	T.M	B-FN/GL @ 60	f
0044	43800	330800	TF.M	B/GL @ 175	vf
0045	43800	330500	TY.M	B	-
0046	44100	330300	TY.F	B	-
0047	44400	330100	T.M	B-FN/GL @ 80	vf
0048	44500	330000	ME.OC	F	-
0049	45000	329800	TY.F	B	-
0050	45200	329800	TY.F	B	-
0051	45500	299000	O.GL	GL	vf
0052	43600	330200	TY.M	B	-
0053	43200	330500	FI.M	B	-
0054	42500	330700	TY.M	B	-
0055	37400	332800	E.DYB	GF	mf
0056	37200	333000	O.LG	GF	mc
0057	37000	333500	E.EB	GF	mc
0058	37600	333200	E.DYB	GF	vc

Site	Location		Soil Classification	Materials	Particle Size
	Easting	Northing			
0059	47400	330500	O.GL	GL	vf
0060	47500	331000	ptO.G	GL	f
0061	47400	331200	GLSZ.GL	GL	vf
0062	47000	331300	O.GL	GL	vf
0063	47600	331300	T.M	B/GL @ 100	vf
0064	47600	331500	O.G	GL	vf
0065	47400	331700	O.GL	GL	vf
0066	48000	331500	T.M	B/GL @ 50	vf
0067	47800	331300	O.GL	GL	vf
0068	48400	331300	T.M	B/GL @ 110	vf
0069	48900	331300	O.G	GL	vf
0070	49500	331300	ME.OC	F	-
0071	49800	331300	GL.GL	GL	vf
0072	50200	331300	O.G	GL	vf
0073	48700	331000	O.GL	GL	vf
0074	47700	330800	O.LG	GL	vf
0075	48200	330800	ME.OC	B	-
0076	48400	330500	ME.OC	B	-
0077	48300	330300	O.LG	GL	vf
0078	48600	330700	O.LC	GF/GL	mc/f
0079	48600	330400	T.M	B/GL @ 50	vf
0080	48600	329700	O.GL	GL	vf
0081	48600	329400	T.F	B/GL @ 100	vf
0082	48600	329100	T.H	B/GL @ 40	vf
0083	48500	332900	GL.GL	GL	f
0084	48300	332900	ptO.LG	GL	vf
0085	47900	332900	T.M	B/GL @ 60	vf
0086	47700	332900	T.H	B/GL @ 80	vf
0087	47400	332900	O.GL	GL	vf

Site	Location		Soil Classification	Materials	Particle Size
	Easting	Northing			
0088	48600	333300	T.F	B/GL @ 90	vf
0089	49100	332900	GL.GL	GL	vf
0090	49300	332900	FI.OC	B	-
0091	49600	332900	O.GL	GF/GL	mc/vf
0092	48400	332700	O.LG	GL	vf
0093	47900	332800	GL.GL	GL	vf
0094	47600	332700	O.LG	GL	vf
0095	46600	332300	O.GL	GL	vf
0096	47600	332200	GL.GL	GL	vf
0101	47200	339300	SZ.GL	GL	vf
0102	47200	339000	SZ.GL	GL	vf
0103	47200	338800	O.GL	GL	vf
0104	47200	338400	O.GL	GL	vf
0105	47400	339300	HU.LG	GL	vf
0106	47700	339300	SZ.GL	GL	vf
0107	48000	339300	G.SS	GL	vf
0108	48000	339700	O.GL	GL	vf
0109	48000	340200	SZ.GL	GL	vf
0110	48000	340500	O.GL	GL	vf
0111	48300	339300	O.GL	GL	vf
0112	48900	339300	O.GL	GL	f
0113	49000	340000	O.GL	GL	f
0114	49400	340200	O.GL	GL	f
0115	49600	340300	O.LG	GL	f
0116	49700	340500	O.GL	GL	f/vf
0117	49900	340600	T.M	B/GL @ 80	vf
0118	50300	340600	O.GL	GL	f
0119	50700	340300	T.M	B/GF @ 100	mc
0120	51000	339800	ME.F	B	-

Site	Location		Soil Classification	Materials	Particle Size
	Easting	Northing			
0121	50600	339500	G.SO	GL	vf
0122	50800	339800	TY.F	B	-
0123	51300	339600	O.LG	GL	vf
0124	51400	339400	O.LG	GL	vf
0125	51700	339200	GL.GL	GL	vf
0126	51900	338900	SZ.GL	GL	vf
0127	52300	338700	O.GL	GL	vf
0128	38700	333800	T.F	B	-
0129	38700	333700	O.GL	GL	vf/f
0130	38700	334000	ME.F	B	-
0131	52200	331300	O.G	GF	mc
0132	52700	331200	O.G	GF/GL	mc/f
0133	52700	330900	G.SS	GL	vf
0134	52700	330400	O.GL	GF/GL	mc/vf
0135	52700	329800	GLG.SS	GL	vf
0136	45600	339500	O.GL	GL	vf
0137	45200	339500	GL.GL	GL	vf
0138	45200	339800	O.GL	GL	vf
0139	45200	342000	T.M	B/GL @ 90	vf
0140	45200	343000	ME.OC	B	-
0141	45200	344000	HU.LG	GL	vf
0142	45500	342000	TME.OC	B/GL @ 50	vf
0143	45800	342000	GL.GL	GL	vf
0144	46200	342000	O.LG	GL	vf
0145	53700	339500	GL.GL	GL	vf
0146	53500	339600	GL.GL	GL	vf
0147	53500	339200	O.GL	GL/M	vf/f
0148	out of area		O.GL	M	f
0149	54200	340500	T.M	B/GL @ 60	vf

Site	Location		Soil Classification	Materials	Particle Size
	Easting	Northing			
0150	53900	340600	O.GL	GL/M	f
0151	52300	339900	E.DYB	GF	vc
0152	49400	337800	O.GL	GL	vf
1001	38300	333800	E.DYB	GF	mc
1002	38300	332800	E.DYB	GF	vc/f
1003	38600	332900	E.DYB	GF	mc
1004	39000	332800	O.GL	GF	mc
1005	39500	332400	E.DYB	GF	vc
1006	39700	332400	O.GL	M	m
1007	40200	332400	O.GL	GL/GF	mc
1008	40400	332700	GL.GL	GF/GL	mf
1009	40400	333000	O.GL	M	m
1010	40400	333500	ptR.G	GF	mc
1011	40100	333500	T.M	B/GL @ 70	mf
1012	40400	333700	T.M	B/GL @ 75	mf
1013	40400	334100	O.EB	GF/GL	mc/vf
1014	40400	332700	O.GL	GL	vf
1015	40300	332900	O.GL	GL	m
1016	40900	331900	O.GL	GL	vf
1017	42400	333400	T.M	B/GL @ 110	vf
1018	42400	333400	T.M	B/GL @ 110	vf
1019	42800	333400	ptR.G	GL	mf
1020	43100	333500	T.M	B/GL @ 80	m
1021	43300	333500	T.M	B/GL @ 60	vf
1022	43600	333900	T.M	B/GL @ 80	vf
1023	43800	334000	TY.M	B	-
1024	44200	334700	T.M	B/GL @ 80	mf
1025	44500	334900	TY.M	B	-
1026	44700	335300	T.M	B/GL @ 80	vf

Site	Location		Soil Classification	Materials	Particle Size
	Easting	Northing			
1027	44500	335500	O.GL	GL	vf
1028	44800	335700	T.M	B/GL @ 70	vf
1029	44300	335700	TY.M	B	-
1030	42700	336200	T.M	B/GL @ 50	vf
1031	42700	336400	T.M	B/GL @ 65	vf
1032	42100	336000	ptR.G	GL	f
1033	42200	336400	ptR.G	GL	mf
1034	42200	336900	ptR.G	GF	vc
1035	42300	337400	T.M	FN/GF	mc
1036	42300	337700	T.M	B/GL	vf
1037	42000	338000	T.M	GF	m
1038	41600	338000	T.M	B/GL @ 60	m/vf
1039	41300	338100	E.DYB	GF	m
1040	41400	338400	GL.DYB	GF	mc
1041	41300	338400	T.M	B/GL @ 60	vf
1042	41000	338500	TY.M	B	-
1043	41600	335700	T.M	B/GF @ 40	m
1044	41300	335700	O.EB	GF/GL	m/vf
1045	39000	335700	GLE.EB	GF	mc
1046	39400	335700	E.DYB	GF	vc
1047	39600	335700	E.DYB	GF	vc
1048	39600	335500	E.EB	GF	mc
1049	39600	335200	E.DYB	GF	vc
1050	39600	334900	O.G	GF/GL	mc/f
1051	39900	335800	E.DYB	GF	vc
1052	39800	336200	BR.GL	GF	vc
1053	39800	336400	E.DYB	GF	mc
1054	40100	335500	O.G	GF/GL	mc/f
1055	41000	335800	O.G	GL	vf

Site	Location		Soil Classification	Materials	Particle Size
	Easting	Northing			
1056	40500	336100	E.DYB	GF	mc
1057	40100	336600	O.EB	GF	mc
1058	40500	336800	ptR.G	GF	m
1059	39000	332800	E.DYB	GF/GL	vc/f
1060	39300	333400	E.DYB	GF	mc
1061	38800	333500	ptR.G	GF	mc
1062	38700	336000	FI.OC	B	-
1063	38900	332300	E.DYB	GF	vc
1064	38800	332100	R.G	GF	vc
1065	39500	332200	E.DYB	GF	vc
1066	42900	335800	ptR.G	GL	m
1067	39600	331700	O.GL	GL	vf
1068	40400	332200	O.GL	GF/GL	m/f
1069	40600	331700	O.GL	M	m
1070	40500	331500	O.GL	M	m
1071	41400	332400	TY.M	B	-
1072	41600	332800	TY.M	B/GL @ 180	vf
1073	41800	332700	TY.M	B/GL @ 200	vf
1074	41600	332900	T.M	B/GL @ 80	vf
1075	42000	332200	T.M	FN/GL @ 75	vf
1076	37400	331500	GL.EB	GF	vc
1077	37600	331800	E.DYB	GF	vc
1078	37400	332000	O.G	GF	mf
1079	44500	334700	G.SS	GL	mf
1080	45000	334800	G.SO	M	mf
1081	45400	334500	G.SO	GL/M	mf
1082	45300	334200	R.G	GL	vf
1083	45300	333700	G.SO	GL/M	vf
1084	45300	333000	G.SO	GL	vf

Site	Location		Soil Classification	Materials	Particle Size
	Easting	Northing			
1085	43600	332800	ptR.G	GL	vf
1086	43900	332800	TY.M	B/GL @ 220	vf
1087	44400	332800	ME.F	B	-
1088	44800	332800	ME.OC	B	-
1089	45300	332500	O.GL	GF	mc
1090	45500	332300	G.SS	GL	vf
1091	46300	332000	G.SO	GL	vf
1092	45600	331600	ptO.G	GL	vf
1093	44700	331800	T.F	B/GL @ 110	vf
1094	45100	331700	TY.M	B	-
1095	45500	331200	TY.M	B	-
1096	45500	330400	G.SS	GL	vf
1097	43700	331500	TY.M	B/GL @ 200	vf
1098	44200	331400	G.SS	GL	vf
1099	44800	331200	TY.M	B	-
1100	45800	330900	G.SS	GL	vf
1101	44700	330500	TY.M	B	-
1102	45100	330400	TY.M	B	-
1103	45700	329800	G.SO	GL	vf
1104	45500	329600	T.M	B/GL @ 50	mf
1105	45000	329400	TY.M	B	-
1106	44500	329600	TY.M	B	-
1107	37300	331000	ptO.G	GL	f
1108	37300	331300	E.DYB	GF	mc
1109	37300	330800	TY.M	B	-
1110	37300	330200	O.LG	GF	vc
1111	37100	329500	E.DYB	GF	vc
1112	37500	330900	E.EB	GF	vc
1113	36900	331100	T.M	B/GL @ 75	f

Site	Location		Soil Classification	Materials	Particle Size
	Easting	Northing			
1114	36800	330800	ME.OC	B	-
1115	36500	330800	E.DYB	GF	mc
1116	36200	330800	ptR.G	GF	mc
1117	35700	330800	caO.EB	GF	m
1118	35900	331000	ptO.G	GF	mc
1119	35900	331300	E.DYB	GF	mc
1120	36300	331300	THU.M	B/GF @ 100	mc
1121	37700	331300	E.DYB	GF	vc
1122	37700	330600	E.DYB	GF	vc
1123	37300	329800	O.DYB	GF	vc
1124	38000	332400	E.EB	GF	vc
1125	37700	332900	O.DYB	GF	vc
1126	37600	333700	E.DYB	GF	mc
1127	37200	334000	O.EB	GF	mc
1128	37700	334100	THU.M	B/GF @ 120	m
1129	37700	334500	E.DYB	GF	mc
1130	37800	335200	GLE.DYB	GF	mc
1131	38500	335500	E.DYB	GF	mc
1132	38700	335800	E.DYB	GF	vc
1133	38900	336700	E.DYB	GF	mc
1134	38900	337200	O.DYB	GF	vc
1135	35700	330000	E.DYB	GF	vc
1136	36200	330100	E.EB	GF	mc
1137	36500	330100	E.EB	GF	mc
1138	36800	329200	E.DYB	GF	vc
1139	36000	329200	E.EB	GF	vc
1140	35300	329200	E.EB	GF/GL	mc/mf
1141	36100	329800	E.DYB	GF	mc
1142	35800	329500	E.DYB	GF	vc

Site	Location		Soil Classification	Materials	Particle Size
	Easting	Northing			
1143	36400	330300	E.EB	GF/TS	vc
1144	37200	329800	E.EB	GF	vc
1145	36900	329600	E.EB	GF/GL	vc/f
1146	37100	329400	E.EB	GF	vc
1147	37600	330000	E.EB	GF	vc
1148	37200	330000	E.EB	GF	vc
1149	37000	334000	E.DYB	GF	vc
1150	37100	334300	O.EB	GF	vc
1151	37500	334200	E.DYB	GF	mc
1152	39000	336500	E.EB	GF	vc
1153	39300	336600	E.EB	GF	mc
1154	39500	336800	E.EB	GF	vc
1155	39700	336900	E.EB	GF	mc
1156	39900	336900	E.EB	GF	mc
1157	39900	337300	E.EB	GF	mc
1158	40300	337000	E.DYB	GF/TS	vc
1159	40100	337000	TY.M	B	-
1160	39800	336500	O.GL	GF	vc
1161	39500	337300	E.DYB	GF	vc
1162	38200	334200	E.DYB	GF	mc
1163	38000	334400	E.EB	GF	mc
1164	37900	334600	E.EB	GF	mc
1165	38200	334700	O.EB	GF	mf
1166	38500	334900	BR.GL	GF	m
1167	38700	335000	E.EB	GL	mc
1168	39100	335200	E.EB	GF	vc
1169	39300	335000	O.G	GF	vc
1170	39200	334700	E.EB	GF	vc
1171	39400	334500	O.G	GF	mc

Site	Location		Soil Classification	Materials	Particle Size
	Easting	Northing			
1172	39600	334000	E.EB	GF/GL	mc/vf
1173	39800	333700	T.M	B/GF @ 40	mf
1174	38000	333700	E.EB	GF	mc
1175	38200	333200	ptO.G	GF	m
1176	48700	328800	ptR.G	B/GL @ 50	f
1177	48700	328400	O.GL	GL	vf
1178	48700	328100	T.M	B/GL @ 75	m/mf
1179	48400	328000	O.GL	GL	f
1180	47700	328000	O.GL	GL	vf
1181	48200	328000	GL.GL	GL	f
1182	47900	329000	ptR.G	GL	vf
1183	49000	328000	T.M	B/GL @ 50	mf/f
1184	49500	328000	T.M	B/GL @ 50	vf
1185	50000	328000	T.M	FN/GL @ 60	vf
1186	49700	328[illegible]0	T.M	FN/GL @ 90	f
1187	48700	327700	ptR.G	GL	vf
1188	48700	327500	T.M	FN/GL @ 120	mf
1189	48700	327200	GL.GL	GL	vf
1190	48700	326900	T.M	B/GL @ 50	f
1191	48700	326500	E.DYB	GL	vf
1192	48400	326500	ptR.G	GL	mf/vf
1193	48100	326400	O.G	GL	vf
1194	47600	326400	O.GL	GL	mf
1195	47700	326400	G.SO	GL	f
1196	48800	326400	ptO.G	GL	mf
1197	49200	326400	T.M	B/GL @ 90	f
1198	49500	326400	ME.OC	B	-
1199	49900	326400	T.M	GL	vf
1200	48700	326200	O.GL	GL	f

Site	Location		Soil Classification	Materials	Particle Size
	Easting	Northing			
1201	48700	325900	GL.GL	GL	vf
1202	48700	325600	FI.OC	B	-
1203	48800	325600	O.GL	GL	vf
1204	49200	325600	T.M	B/GL @ 120	f
1205	49500	325600	T.H	B/GL @ 75	
1206	49800	325600	ptO.G	GL	vf
1207	50300	325600	T.H	B/GL @ 50	vf
1208	50300	325300	GLE.EB	GL	vf
1209	50300	324900	GL.GL	GL	f
1210	50100	324800	T.M	FN/GL @ 40	vf
1211	50300	324500	O.GL	GL	mf
1212	50300	324300	T.M	B/GL @ 110	vf
1213	50300	324100	GL.GL	GL/M	f
1214	50300	323700	ptR.G	GL	f
1215	50300	323500	T.M	FN/GL @ 75	vf
1216	50100	323100	GL.GL	GL	vf
1217	50300	322800	ptR.G	GL	f
1218	48700	325400	O.GL	GL	vf
1219	48700	325100	O.GL	GL	vf
1220	49000	329700	T.M	FN/GL @ 75	f
1221	49000	329300	ptR.G	GL	f
1222	48300	329300	T.F	B/GL @ 75	vf
1223	48100	329300	GL.GL	GL	vf
1224	48100	329500	O.G	GL	vf
1225	47700	329300	O.GL	GL	vf
1226	47500	329300	O.GL	GL	vf
1227	47200	329300	O.GL	GL	vf
1228	46800	329300	O.GL	GL	vf
1229	46800	329100	O.GL	GL	vf

Site	Location		Soil Classification	Materials	Particle Size
	Easting	Northing			
1230	46700	328800	O.GL	M	m
1231	47000	329800	O.GL	GL	vf
1232	47000	329600	O.GL	GL	vf/f
1233	49300	329300	ptR.G	GL	mf
1234	49600	329300	O.GL	GL	vf
1235	50300	329300	O.GL	GL	vf
1236	50300	329600	ptR.G	GL	vf
1237	51700	329300	O.G	GL	vf
1238	52000	329300	O.GL	GL	vf
1239	52400	329300	SZ.GL	GL	vf
1240	52600	329300	G.SO	GL	mf
1241	53000	329300	G.SO	GL	mf
1242	53200	329600	O.GL	GL	f
1243	54700	329300	GL.GL	GL	vf
1244	54500	329300	G.SS	GL	vf
1245	54000	329300	G.SS	GL	f
1246	53700	329300	O.GL	GL	vf
1247	53400	329300	GL.GL	GL	vf
1248	54800	329800	GL.GL	GL	vf
1249	54800	329600	O.GL	GL	vf
1250	55200	329300	G.SO	GL	vf
1251	55500	329300	O.GL	GL	f
1252	55700	329300	O.GL	GL	vf
1253	56200	329300	O.GL	GL	f
1254	56400	329300	O.G	GL	f/vf
1255	56100	329500	O.GL	GL	vf
1256	56100	329500	O.GL	GL	f
1257	56600	330200	O.GL	GL	f
1258	56700	330800	O.GL	GL	mf

Site	Location		Soil Classification	Materials	Particle Size
	Easting	Northing			
1259	56400	331000	O.GL	GL	vf
1260	56300	331000	O.GL	GL	vf
1261	55900	331300	O.GL	GL	vf
1262	55600	331500	O.GL	GL	vf
1263	55300	331600	GL.GL	GL	mf
1264	55000	332000	O.GL	GL	vf
1265	54700	332200	O.GL	GL	vf
1266	54500	332400	O.GL	GL	f
1267	37700	329800	O.DYB	GF	mc
1268	37700	329600	O.DYB	GF	mc
1269	38400	329600	O.DYB	GF	mc
1270	38500	329800	O.DYB	GF	mc
1271	38100	329800	O.DYB	GF	vc
1272	54100	333200	O.GL	GL	vf
1273	54200	332600	O.GL	GL	vf
1274	53600	333300	O.GL	GL	f
1275	53500	333300	GL.GL	GL	f
1276	53300	333400	O.GL	GL	vf
1277	52900	333700	ptR.G	GL	vf
1278	52600	333900	T.M	B/GL @ 100	f
1279	52400	334200	T.M	B/GL @ 50	vf
1280	52200	334300	T.M	B/GL @ 50	mf/f
1281	52100	334400	T.M	B/GL @ 70	vf
1282	52300	334400	T.M	B/GL @ 100	vf
1283	52500	334400	T.M	B/GL @ 75	f
1284	52700	334500	T.M	B/GF @ 75	vc/mf
1285	53000	334500	ptR.G	GF	mf
1286	53000	334300	T.M	B/GF @ 60	mc
1287	53000	334300	ptO.G	GF	mc

Site	Location		Soil Classification	Materials	Particle Size
	Easting	Northing			
1288	53500	334600	O.GL	GL	f
1289	53700	334600	T.M	B/GF @ 50	mc/mf
1290	53900	334600	T.M	FN/GL @ 70	mf
1291	54200	334600	GL.GL	GL	vf
1292	54400	334600	O.GL	GL	vf
1293	54500	334400	T.M	B/GL @ 95	vf
1294	54300	334200	T.M	B/GL @ 60	vf
1295	54300	334000	T.M	B/GL @ 100	vf
1296	54200	333500	O.GL	GL	vf
1297	54600	334600	T.M	B/GL @ 50	vf
1298	54800	334600	ME.OC	B	-
1299	5500	334700	O.GL	GL	mf
1300	33100	335000	O.GL	GL	f
1301	55500	334800	O.GL	GL	vf
1302	55400	335600	TME.F	B-FN/GL @ 100	vf
1303	55000	334500	O.GL	GL	f
1304	55000	334300	ptR.G	GL	vf
1305	54900	332900	T.M	B/GL @ 45	f
1306	54900	333700	T.M	B/GL @ 100	vf
1307	48700	337500	T.M	B/GL @ 75	vf
1308	48500	337700	O.GL	GL	vf
1309	48400	337500	GL.GL	GL	mf
1310	48200	337500	O.GL	GL	f/mf
1311	48000	337200	O.GL	GL	vf/f
1312	37700	336800	O.GL	GL	vf
1313	37600	336700	O.GL	GL	vf
1314	37400	336700	O.GL	GL	vf/vc
1315	37200	336900	O.GL	GL/M	mf/m
1316	47000	337100	O.GL	GL	vf

Site	Location		Soil Classification	Materials	Particle Size
	Easting	Northing			
1317	47000	337400	O.GL	GL	vf
1318	46500	337300	O.GL	GL	vf
1319	46300	337300	TM[illegible].H	B/GL @ 80	mf
1320	54500	333400	O.GL	GL	vf
1321	54900	333400	T.M	B/GL @ 40	vf
1322	55000	333200	ptR.G	GL	vf
1323	55000	332900	GL.GL	GL	vf
1324	55000	332600	HU.LG	GL	vf
1325	54300	332500	O.GL	GL	vf
1326	54700	332500	O.LG	GL	f/vf
1327	56000	333000	GLG.SO	GL	vf
1328	56300	332800	T.F	B/GL @ 100	vf
1329	55700	332700	ptR.G	GL	vf
1330	55700	332600	GL.GL	GL	vf
1331	54600	332200	O.LG	GL	f
1332	54600	332000	O.LG	GL	vf
1333	55800	331900	O.GL	GF/SS	vf
1334	56200	331800	O.GL	GL	vf
1335	56400	331700	O.GL	GL	f
1336	55100	334100	T.H	B/GL @ 40	f
1337	55500	334000	T.M	B/GL @ 60	vf
1338	55400	333700	ptR.G	GL	vf
1339	55800	333800	T.M	B/GL @ 50	vf
1340	56100	333700	T.F	FN/GL @ 90	vf
1341	56200	334000	T.M	B/GL @ 50	mf/vf
1342	56300	334300	T.M	B/GL @ 75	vf
1343	56300	334400	GL.GL	GL	vf
1344	56300	333700	T.M	B/GL @ 45	vf
1345	56400	333700	GL.GL	GL	vf

Site	Location		Soil Classification	Materials	Particle Size
	Easting	Northing			
1346	52300	334600	ME.OC	B	-
1347	52400	334800	T.M	FN/GL @ 80	f
1348	42600	335000	O.LG	GF/GL	vc/vf
1349	52800	335000	GLE.DYB	GF	vc
1350	53000	334900	R.G	GL	vf
1351	52600	335300	GL.GL	GL	vf
1352	52800	335500	ptR.G	GL	mf/f
1353	53000	335700	ptR.G	B/GF	m
1354	52900	335900	ptR.G	GF/GL	vc/vf
1355	53400	336100	GL.GL	GF/GL	vc/vf
1356	53500	336400	O.GL	GL	f
1357	53500	335800	GLE.DYB	GF/GL	vc/vf
1358	53800	335700	O.GL	GL	f
1359	54200	335600	ptR.G	GL	vf
1360	54300	335900	GL.DYB	GF/GL	mc/vf
1361	54500	335500	O.LG	GL	vf
1362	54700	335400	O.LG	GL	f
1363	54000	335400	GL.GL	GL	mf
1364	53900	335000	ptR.G	GL	vf
1365	51900	334400	O.LG	GL	vf
1366	51700	334200	ME.OC	FN	-
1367	51600	334000	ME.OC	B	-
1368	51400	333700	ME.OC	B	-
1369	51200	333500	FI.OC	B	-
1370	50200	332900	G.SS	GL	vf
1371	50400	332900	G.SO	GL	vf
1372	50700	332900	O.LG	GL	vf
1373	50800	333100	O.EB	GL	vf
1374	51000	333300	O.GL	GL	mf

Site	Location		Soil Classification	Materials	Particle Size
	Easting	Northing			
1375	51800	334600	GL.DYB	GF/GL	mc/f
1376	51600	334800	T.M	FN/GL @ 70	vf
1377	51300	335000	TY.F	B	-
1378	51200	335200	FI.M	B	-
1379	50900	335400	GLO.GL	GL	vf
1380	50700	335600	O.GL	GL	vf
1381	50500	335800	O.GL	GL	vf
1382	50400	336000	GL.GL	GF/GL	mc/vf
1383	50500	336300	O.GL	GL	vf
1384	50000	336300	ptR.G	GL	f
1385	49800	336400	ptR.G	GL	mf
1386	49700	336500	T.F	B/GL @ 80	vf
1387	49400	336700	TFI.M	B	-
1388	49200	337000	T.F	B/GL @ 115	vf
1389	48900	337300	TY.F	B	-
1390	48600	337300	T.M	B/GL @ 70	vf
1391	48600	337200	O.LG	GL	mf/f
1392	48600	336900	T.F	B/GF @ 100	mc
1393	48600	336700	T.F	B/GL @ 50	vf
1394	48600	336300	T.M	B/GL @ 110	vf
1395	48500	336200	T.M	B/GL @ 60	vf
1396	48100	336200	T.M	B/GL @ 75	vf
1397	47700	336200	ptR.G	GL	vf
1398	47400	336200	O.GL	GL	vf
1399	48700	336200	TY.F	F	-
1400	49200	336200	ME.OC	B	-
1401	49200	336200	T.M	B/GL @ 90	-
1402	48600	335900	FI.OC	B	-
1403	48600	335600	T.M	FN/GL @ 45	vf

Site	Location		Soil Classification	Materials	Particle Size
	Easting	Northing			
1404	48800	335700	O.GL	GL	vf
1405	49200	335600	THU.M	B/GL @ 50	vf
1406	49600	335500	TME.F	B/GL @ 85	vf
1407	49800	335400	GL.GL	GL	vf
1408	49700	335300	T.M	B/GL @ 45	mf/vf
1409	49400	335400	T.M	FN/GL @ 85	m
1410	49100	334000	T.M	FN/GL @ 55	vf
1411	49100	335300	T.M	FN/GL @ 45	vf
1412	40800	335200	TY.M	FN	-
1413	48600	335400	T.H	FN/GL @ 50	vf
1414	48600	334800	O.GL	M	vf
1415	48600	334600	T.F	B/GL @ 80	mf
1416	48800	334500	T.F	B/GL @ 90	vf
1417	49300	334600	T.F	B/GL @ 90	vf
1418	49500	334700	T.M	B/GL @ 100	vf
1419	49700	334700	T.M	FN/GL @ 50	vf
1420	49500	334500	ptR.G	GL	vf
1421	49500	334300	ptR.G	GL	vf
1422	49500	334000	T.F	B/GL @ 60	vf
1423	48300	334500	T.M	F/GL @ 90	vf
1424	48100	334500	O.GL	GL	vf
1425	47900	334700	T.M	FN/GL @ 60	vf
1426	48100	334300	TME.F	B/GL @ 70	mf/f
1427	48000	334100	T.M	B/GL @ 45	mf/vf
1428	47700	334500	ptO.LG	GL	vf
1429	47400	334500	ptR.G	GL	vf
1430	47300	334900	TME.OC	FN	-
1431	47500	334900	T.M	FN	-
1432	47500	334300	T.M	FN/GL @ 60	vf

Site	Location		Soil Classification	Materials	Particle Size
	Easting	Northing			
1433	47200	334200	T.M	FN/GL @ 90	mf
1434	46900	334000	TME.F	B/GL @ 90	vf
1435	46800	334400	ptO.LG	GL	vf
1436	46400	333700	T.M	FN/GL @ 40	vf
1437	46200	333800	T.M	FN/GL @ 75	vf
1438	46300	333900	O.GL	GL	f
1439	46800	333400	GLG.SO	GL	vf
1440	46700	333100	O.GL	GL	vf
1441	46800	332800	O.GL	GL	vf
1442	46900	332500	O.GL	GL	vf
1443	47200	333600	T.F	B/GL @ 90	f
1444	47500	333500	ptR.G	GL	vf
1445	48600	334200	TME.F	B/SS @ 100	vf
1446	48600	333800	T.M	FN/GL @ 75	vf
1447	49000	333700	TME.F	B/GL @ 90	vf
1448	46400	333800	THU.M	FN/GL @ 75	vf
1449	55900	335300	E.DYB	GF/GL	mc/f
1450	56300	335400	O.GL	GL	vf
1451	56500	335200	GL.GL	GL	vf
1452	46500	335600	TME.F	B	-
1453	46400	335700	O.GL	GL	mf
1454	55000	336400	O.LG	GL	f
1455	54700	336600	T.F	B/GL @ 80	vf
1456	54500	336700	ptR.G	GL	f/vf
1457	54400	336900	O.GL	GL/M	mf
1458	54100	337100	FI.M	B	-
1459	53800	337300	O.LG	GL	vf
1460	53700	337000	ME.OC	B	-
1461	53500	337400	O.GL	GL/M	vf/mf

Site	Location		Soil Classification	Materials	Particle Size
	Easting	Northing			
1462	53600	337800	O.GL	GL/M	mf/m
1463	53400	337700	O.GL	GL	vf
1464	53200	337900	O.GL	GL	vf
1465	53000	338100	O.GL	GL/M	vf/mf
1466	52700	338400	O.GL	GL	vf
1467	52500	338500	O.LG	GF/GL	mc/vf
1468	52400	338100	TY.M	FN	-
1469	52500	338300	T.M	B/GF @ 75	mc
1470	52800	338600	GL.GL	GL/M	vf/mf
1471	52900	338700	GL.GL	GL	vf
1472	53200	338900	GL.GL	GL	vf
1473	48600	323000	T.F	B/GL @ 110	vf
1474	48800	323400	TY.F	B	-
1475	48800	323600	O.GL	GL	vf
1476	48900	323800	G.SO	GL	vf
1477	49000	324000	GLG.SS	GL	vf
1478	49200	324300	ptR.G	GL	mf
1479	52900	329300	GL.GL	GL	vf
1480	38500	335400	E.DYB	GF	mc
1481	38800	336800	T.M	FN/GF @ 130	m
1482	38100	332300	O.DYB	GF	vc
2000	52100	331100	T.M	B/GL @ 45	vf
2001	52100	330800	O.GL	GL	vf
2002	52100	330500	O.GL	GL	mf
2003	52100	330200	O.GL	GL	vf
2004	52100	329800	GL.GL	GL	vf
2005	48500	324200	GL.GL	GL	f
2006	48700	324200	TY.F	B	-
2007	49000	324200	ptR.G	GL	vf

Site	Location		Soil Classification	Materials	Particle Size
	Easting	Northing			
2008	49300	324200	T.M	B/GL @ 100	vf
2009	49800	324200	GL.GL	GL	vf
2010	50000	324200	O.GL	GL	vf

APPENDIX D

LABORATORY SHEETS

NORWEST LABS

DATE	19-SEP-84
P.O. NO	
W.O. NO	11750

FEDOCAN LAND LTD
4211-95 STREET
EDMONTON
ALBERTA
T6E 5R6

LEASE 22

SYNCRUDE

		ASH	PH	EC mS/cm	%CACO3 equiv.	SAND %	SILT %	CLAY %	TEXTURE	ORG MAT %	TOT C %
101 0010 OF	0-30	4.35	4.6							87.2	50.7
102 0010 OH	50-70	14.4	5.4							85.3	49.6
103 0010 CG	70-100		5.4				0	0			
104 0010 CG	100-120		5.6			27.0	39.0	34.0	CL.		
105 0016 H	12-0		7.3	0.76						56.9	33.1
106 0016 BG	0-60		7.6	0.58	2.27						
107 0016 CKG	60-90		8.0	0.48	6.37						
108 0016 IICKG	90-120		8.2	0.38	8.64						
109 0030 OF	0-40	3.75	3.4							84.1	48.9
110 0030 OF	50-70	3.42	3.5							86.0	50.0
111 0030 OF2	70-100	3.92	3.9							92.5	53.8

		TOT N %	CN RATI	CEC mg/100	EXC CA mg/100	EXC MG mg/100	EXC K mg/100	EXC NA mg/100	% FIBRE unrub	% FIBRE rubbed
101 0010 OF	0-30	0.59	85.9	36.4	8.2	6.5	0.9	0.8	96	82
102 0010 OH	50-70	1.58	31.4	72.6	38.7	11.8	0.1	1.0	52	36
103 0010 CG	70-100			143	63.5	18.3	0.1	2.6		
104 0010 CG	100-120			20.7	15.3	4.3	0.1	0.8		
105 0016 H	12-0	0.99	33.4							
106 0016 BG	0-60									
107 0016 CKG	60-90									
108 0016 IICKG	90-120									
109 0030 OF	0-40	0.86	56.9	243	8.3	2.0	0.3	0.1	88	72
110 0030 OF	50-70	0.61	82.0	67.1	12.3	2.1	0.1	0.1	90	68
111 0030 OF2	70-100	0.77	69.9	55.7	16.9	2.4	0.1	0.1	88	74

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		ASH	PH	EC mS/cm	%CACO3 equiv.	SAND %	SILT %	CLAY %	TEXTURE	ORG MAT %	TOT C %
112 0043 OM	0-40	14.5	5.5							86.7	50.4
113 0043 OM	40-60	10.6	5.3							82.6	48.0
114 0043 CG	60-100		5.7			24.0	24.0	52.0	C.		
115 0051 AE	0-15		5.3							0.6	0.34
116 0051 BT	18-35		5.2								
117 0051 BC	70-90		7.6	4.00	2.73						
118 0051 CK	100-120		7.8	4.60	5.91						
119 0056 OM	5-20		7.6	1.13	5.68					57.4	33.4
120 0056 AE	20-25		7.9	0.45	1.82					1.3	0.75
121 0056 BMG	25-60		8.0	0.36	2.27						
122 0056 CKG	90-110		8.2	0.55	4.55						

		TOT N %	CN RATI	CEC mg/100	EXC CA mg/100	EXC MG mg/100	EXC K mg/100	EXC NA mg/100	% FIBRE unrub	% FIBRE rubbed
112 0043 OM	0-40	1.04	48.5	117	55.3	9.7	0.1	0.9	80	66
113 0043 OM	40-60	0.72	66.7	66.9	38.0	5.4	0.1	0.5	72	58
114 0043 CG	60-100			17.1	13.1	2.6	0.2	0.3		
115 0051 AE	0-15	0.03	11.3							
116 0051 BT	18-35									
117 0051 BC	70-90									
118 0051 CK	100-120									
119 0056 OM	5-20	1.33	25.1							
120 0056 AE	20-25	0.06	12.5							
121 0056 BMG	25-60									
122 0056 CKG	90-110									

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		ASH	PH	EC mS/cm	%CACO3 equiv.	SAND %	SILT %	CLAY %	TEXTURE	ORG MAT %	TOT C %
123 0068 OF	0-40	4.61	3.2							87.0	50.6
124 0068 OM1	40-80	4.30	3.6							89.4	52.0
125 0068 AM2	80-110	20.3	4.5							77.2	44.9
126 0081 OF1	0-30	5.32	3.9							84.5	49.1
127 0081 OF2	30-60	5.68	4.1							79.5	46.2
128 0081 OF3	60-90	7.43	4.6							81.4	47.3
129 0081 CG	100-120		5.7			16.0	23.0	61.0	HC.		
130 0086 OM	0-50	18.2	5.9							76.9	44.7
131 0086 OH	50-80	30.6	5.8							68.5	39.8
132 0086 CG	80-120		6.6			28.0	39.0	33.0	CL.		
133 0088 OF	20-30		3.6							80.3	46.7

		TOT N %	CN RATI	CEC mg/100	EXC CA mg/100	EXC MG mg/100	EXC K mg/100	EXC NA mg/100	% FIBRE unrub	% FIBRE rubbed
123 0068 OF	0-40	0.88	57.5	56.3	7.3	2.3	0.3	0.0	66	42
124 0068 OM1	40-80	1.15	45.2	62.9	13.1	3.1	0.1	0.1	92	76
125 0068 AM2	80-110	1.76	25.5	130	56.3	9.7	0.1	0.4	60	36
126 0081 OF1	0-30	0.87	56.4	63.1	12.3	5.2	0.3	1.1	68	46
127 0081 OF2	30-60	0.67	69.0	55.7	17.7	6.5	0.1	0.9	92	62
128 0081 OF3	60-90	0.79	59.9	74.9	33.8	7.6	0.1	0.6	88	70
129 0081 CG	100-120			20.3	15.3	5.5	0.3	0.2		
130 0086 OM	0-50	1.63	27.4	73.7	46.1	14.3	0.1	0.6	64	48
131 0086 OH	50-80	1.90	20.9	60.3	42.5	10.6	0.1	0.5	50	22
132 0086 CG	80-120			14.9	11.7	4.7	0.2	0.2		
133 0088 OF	20-30									

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		ASH	PH	EC mS/cm	%CACO3 equiv.	SAND %	SILT %	CLAY %	TEXTURE	ORG MAT %	TOT C %
134 0106 LF	5-0		4.5							56.4	32.8
135 0106 AE	0-15		5.1			30.0	49.0	21.0	L.	1.6	0.93
136 0106 BTNJ	15-60		5.9			20.0	19.0	61.0	HC.		
137 0106 BC	60-90		7.9	2.94	4.09	33.0	26.0	41.0	C.		
138 0106 CK	90-120		8.0	3.64	5.00	28.0	27.0	45.0	C.		
139 0120 OF1	0-50	4.07	3.8							81.9	47.6
140 0120 OF2	50-100	3.90	4.0							85.8	49.9
141 0120 OM	100-130	9.12	4.7							79.3	46.1
142 0128 OF2	10-30		6.4							77.9	45.3
143 0128 OF3	30-40		5.8							83.1	48.3
144 0128 OF4	50-60		5.7							81.4	47.3

		TOT N %	CN RATI	CEC ma/100	EXC CA ma/100	EXC MG ma/100	EXC K ma/100	EXC NA ma/100	% FIBRE unrub	% FIBRE rubbed
134 0106 LF	5-0	0.92	35.7	29.9	11.2	2.2	1.1	0.2		
135 0106 AE	0-15	0.05	18.6	7.2	2.3	1.5	0.1	0.2		
136 0106 BTNJ	15-60			21.7	9.6	9.2	0.2	3.3		
137 0106 BC	60-90			15.3	11.6	7.1	0.2	2.0		
138 0106 CK	90-120			14.3	16.8	6.8	0.2	2.6		
139 0120 OF1	0-50	0.62	76.8	56.0	10.7	6.1	0.1	0.4	88	76
140 0120 OF2	50-100	0.58	86.0	63.1	17.1	8.1	0.1	0.3	82	64
141 0120 OM	100-130	1.09	42.3	61.4	21.6	8.7	0.1	0.2	82	58
142 0128 OF2	10-30									
143 0128 OF3	30-40									
144 0128 OF4	50-60									

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SYNCRUDE

		ASH	PH	EC mS/cm	%CACO3 equiv.	SAND %	SILT %	CLAY %	TEXTURE	ORG MAT %	TOT C %
145 0129 LH	0-1		5.5							20.8	12.1
146 0129 AE	5-15		7.8	0.46	1.82	40.0	47.0	13.0	L.	0.9	0.51
147 0129 BT	16-24		7.4	0.30		31.0	20.0	49.0	C.		
148 0129 BC	45-60		7.9	0.29	1.36	34.0	27.0	39.0	CL.		
149 0129 CK	85-100		8.2	0.68	5.91	44.0	31.0	25.0	L.		
150 0130 OF1	10-20		3.2							81.0	47.1

		TOT N %	CN RATI	CEC mg/100	EXC CA mg/100	EXC MG mg/100	EXC K mg/100	EXC NA mg/100	% FIBRE unrub	% FIBRE rubbed
145 0129 LH	0-1	0.63	19.2	26.2	17.4	2.1	0.5	0.1		
146 0129 AE	5-15	0.04	12.8	4.4	15.4	0.5	0.1	0.1		
147 0129 BT	16-24			15.9	14.4	4.3	0.3	0.1		
148 0129 BC	45-60			7.9	12.4	5.6	0.2	0.3		
149 0129 CK	85-100			16.7	14.3	2.8	0.1	0.3		
150 0130 OF1	10-20									

ANALYST

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SYNCRUDE

		ASH	PH	EC mS/cm	%CACO3 equiv.	SAND %	SILT %	CLAY %	TEXTURE	ORG MAT %	TOT C %
101 0130 OF2	30-40		3.3							82.7	48.1
102 0130 OFZ	50-60		3.4							2.6	1.53
103 0130 OM	100-120		5.1							83.6	48.6
104 0147 LF	3-0		5.1							68.1	39.6
105 0147 AE	0-15		5.3							0.7	0.40
106 0147 BT(NJ)	15-50		4.9								
107 0147 CK	80-100		8.0	0.61	6.37						
108 0149 OF	0-30	10.9	5.7							82.4	47.9
109 0149 OM	30-60	13.9	5.8							78.4	45.6
110 0149 CG	60-90		5.8			28.0	33.0	39.0	CL.		
111 0151 AE	0-15		7.3	0.52		88.0	9.0	3.0	S.	1.0	0.57

		TOT N %	CN RATI	CEC mg/100	EXC CA mg/100	EXC MG mg/100	EXC K mg/100	EXC NA mg/100	% FIBRE unrub	% FIBRE rubbed
101 0130 OF2	30-40									
102 0130 OFZ	50-60									
103 0130 OM	100-120	1.84	26.4							
104 0147 LF	3-0	1.02	38.8							
105 0147 AE	0-15	0.03	13.3							
106 0147 BT(NJ)	15-50									
107 0147 CK	80-100									
108 0149 OF	0-30	1.27	37.7	71.4	36.0	11.2	0.2	0.5	76	60
109 0149 OM	30-60	1.22	37.4	81.4	45.1	11.5	0.1	0.5	72	44
110 0149 CG	60-90			17.7	12.0	4.1	0.2	0.1		
111 0151 AE	0-15	0.02	28.5	1.9	3.7	0.3	0.1	0.1		

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SYNCRUDE

		ASH	PH	EC mS/cm	%CACO3 equiv.	SAND %	SILT %	CLAY %	TEXTURE	ORG MAT %	TOT C %
112 0151 BM	15-60		6.3			89.0	6.0	5.0	S.		
113 0151 BC	70-120		6.2			90.0	6.0	4.0	S.		
114 1008 AEGJ	0-15		5.8							0.7	0.42
115 1008 IIBTGJ	15-45		6.9								
116 1008 IICGJ	70-100		7.5	0.88	1.36						
117 1021 OM	0-40	11.5	5.2							78.4	45.6
118 1021 OMZ	40-60	12.1	5.4							78.1	45.4
119 1021 CG	60-100		5.6			18.0	47.0	35.0	SiCL.		
120 1025 OM1	0-50	4.08	3.4							80.3	46.7
121 1025 OMZ	50-65	4.90	3.4							79.3	46.1
122 1025 OM2	75-110	4.85	4.0							85.7	49.8

		TOT N %	CN RATI	CEC meq/100	EXC CA meq/100	EXC MG meq/100	EXC K meq/100	EXC NA meq/100	% FIBRE unrub	% FIBRE rubbed
112 0151 BM	15-60			1.9	0.5	0.2	0.1	0.1		
113 0151 BC	70-120			1.7	0.4	0.2	0.1	0.1		
114 1008 AEGJ	0-15	0.03	14.0							
115 1008 IIBTGJ	15-45									
116 1008 IICGJ	70-100									
117 1021 OM	0-40	1.10	41.5	69.4	30.6	18.0	0.2	1.2	86	76
118 1021 OMZ	40-60	1.28	35.5	85.7	47.0	16.5	0.1	1.2	74	52
119 1021 CG	60-100			16.4	9.7	3.0	0.1	0.6		
120 1025 OM1	0-50	0.89	52.5	56.6	4.9	1.7	0.4	0.2	86	74
121 1025 OMZ	50-65	0.79	58.4	69.4	6.4	1.9	0.1	0.2	90	72
122 1025 OM2	75-110	0.64	77.8	65.4	15.5	4.4	0.1	0.2	76	56

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SYNCRUDE

		ASH	PH	EC mS/cm	ZCACO3 equiv.	SAND %	SILT %	CLAY %	TEXTURE	ORG MAT %	TOT C %
123 1040 BMGJ	0-40		8.1	0.34	2.27						
124 1040 BCGJ1	40-60		7.9	0.31	1.36						
125 1040 BCGJ2	60-100		7.9	0.28	0.91						
126 1046 AE	0-15		3.8			89.0	8.0	3.0	S.	1.0	0.59
127 1046 BM	25-40		3.7			88.0	5.0	7.0	LS.		
128 1046 BC	50-70		3.8			91.0	4.0	5.0	S.		
129 1046 BC	70-90		3.8			92.0	3.0	5.0	S.		
130 1060 AE	0-5		5.1			44.0	49.0	7.0	SL.	1.5	0.86
131 1060 BM	5-45		5.0			44.0	41.0	15.0	L.		
132 1060 BC	45-80		5.3			84.0	9.0	7.0	LS.		
133 1065 AE	0-10		6.3							0.4	0.23

		TOT N %	CN RATI	CEC mg/100	EXC CA mg/100	EXC MG mg/100	EXC K mg/100	EXC NA mg/100	% FIBRE unrub	% FIBRE rubbed
123 1040 BMGJ	0-40									
124 1040 BCGJ1	40-60									
125 1040 BCGJ2	60-100									
126 1046 AE	0-15	0.03	19.7	2.8	0.1	0.1	0.1	0.1		
127 1046 BM	25-40			4.1	0.4	0.2	0.1	0.1		
128 1046 BC	50-70			4.7	0.1	0.1	0.1	0.0		
129 1046 BC	70-90			3.2	0.1	0.0	0.1	0.0		
130 1060 AE	0-5	0.07	12.3	7.7	2.7	1.2	0.2	0.0		
131 1060 BM	5-45			8.1	2.7	1.9	0.3	0.0		
132 1060 BC	45-80			5.1	1.5	1.0	0.1	0.1		
133 1065 AE	0-10	0.03	7.67							

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SYNCRUDE

			ASH	PH	EC mS/cm	%CACO3 equiv.	SAND %	SILT %	CLAY %	TEXTURE	ORG MAT %	TOT C %
134	1065 BM	15-30		6.4								
135	1065 BC	60-100		7.3	0.18							
136	1067 AE	0-8		4.8							1.1	0.63
137	1067 BNTGJ	8-40		4.4								
138	1067 C	60-80		4.5								
139	1070 AE	0-15		5.7							1.2	0.68
140	1070 BT	17-35		5.5								
141	1070 BC2	60-70		7.9	0.39	5.91						
142	1070 CK	80-90		8.1	0.42	8.64						
143	1074 OM1	0-20	12.3	5.7							77.4	45.0
144	1074 OM2	35-60	11.6	5.3							85.3	49.6

			TOT N %	CN RATI	CEC meq/100	EXC CA meq/100	EXC MG meq/100	EXC K meq/100	EXC NA meq/100	% FIBRE unrub	% FIBRE rubbed
134	1065 BM	15-30									
135	1065 BC	60-100									
136	1067 AE	0-8	0.04	15.8							
137	1067 BNTGJ	8-40									
138	1067 C	60-80									
139	1070 AE	0-15	0.04	17.0							
140	1070 BT	17-35									
141	1070 BC2	60-70									
142	1070 CK	80-90									
143	1074 OM1	0-20	1.63	27.6	103	27.9	7.3	0.6	1.0	82	58
144	1074 OM2	35-60	1.31	37.9	93.7	40.7	5.4	0.1	1.0	66	28

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		ASH	PH	EC mS/cm	%CACO3 equiv.	SAND %	SILT %	CLAY %	TEXTURE	ORG MAT %	TOT C %
145 1074 OM2	60-80	7.78	5.8							84.8	49.3
146 1074 CG	90-120		6.7			29.0	26.0	45.0	C.		
147 1079 AE	0-15		5.6							1.2	0.69
148 1079 BNT	15-30		4.7								
149 1079 CSK	50-75		7.1								
150 1079 IICK	75-100		8.3	1.20	13.6						

		TOT N %	CN RATI	CEC meq/100	EXC CA meq/100	EXC MG meq/100	EXC K meq/100	EXC NA meq/100	% FIBRE unrub	% FIBRE rubbed
145 1074 OM2	60-80	1.60	30.8	55.1	28.8	6.4	0.1	1.0	80	54
146 1074 CG	90-120			17.4	13.7	3.3	0.2	0.4		
147 1079 AE	0-15	0.04	17.3							
148 1079 BNT	15-30									
149 1079 CSK	50-75									
150 1079 IICK	75-100									

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		ASH	PH	EC mS/cm	%CACO3 equiv.	SAND %	SILT %	CLAY %	TEXTURE	ORG MAT %	TOT C %
101 1053 BM	0-10		5.8								
102 1053 AE	10-20		5.2							2.5	1.44
103 1053 BM	20-35		5.8								
104 1053 BC	60-75		5.6								
105 1053 BCG	80-100		5.3								
106 1088 OM1	0-30	2.86	3.5							83.4	48.5
107 1088 OM2	30-75	3.44	3.6							81.7	47.5
108 1088 OM2	75-110	2.40	3.6							90.3	52.5
109 1099 OF	0-30	3.93	3.6							78.1	45.4
110 1099 OM2	30-75	4.17	3.9							88.2	51.3
111 1099 OM	75-120	4.13	3.8							84.6	49.2

		TOT N %	CN RATI	CEC mg/100	EXC CA mg/100	EXC MG mg/100	EXC K mg/100	EXC NA mg/100	% FIBRE unrub	% FIBRE rubbed
101 1053 BM	0-10									
102 1053 AE	10-20	0.17	8.47							
103 1053 BM	20-35									
104 1053 BC	60-75									
105 1053 BCG	80-100									
106 1088 OM1	0-30	0.61	79.5	35.1	2.6	1.2	0.2	0.1	76	68
107 1088 OM2	30-75	0.95	50.0	53.7	6.8	3.6	0.2	0.7	82	74
108 1088 OM2	75-110	0.79	66.5	55.4	6.9	3.9	0.1	0.8	82	76
109 1099 OF	0-30	0.56	81.1	22.2	3.0	1.4	0.3	0.1	92	82
110 1099 OM2	30-75	0.87	59.0	59.4	7.9	2.9	0.1	0.3	74	50
111 1099 OM	75-120	0.64	76.9	64.6	11.8	3.7	0.1	0.3	92	76

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		ASH	PH	EC mS/cm	%CACO3 equiv.	SAND %	SILT %	CLAY %	TEXTURE	ORG MAT %	TOT C %
112 1099 OM	120-210	5.71	4.4							16.7	9.70
113 1103 AE	0-6		6.3			49.0	35.0	16.0	L.	1.1	0.65
114 1103 BNT	12-40		5.0			21.0	17.0	62.0	HC.		
115 1103 BC	40-75		6.1			15.0	17.0	68.0	HC.		
116 1103 CK	90-110		7.7	0.36	2.73	19.0	19.0	62.0	HC.		
117 1112 AE	0-5		5.7			95.0	2.0	3.0	S.	1.7	1.00
118 1112 BM	10-50		6.7			95.0	1.0	4.0	S.		
119 1112 C	60-100		6.3			95.0	1.0	4.0	S.		
120 1127 BM	0-30		5.1			53.0	37.0	10.0	SL.		
121 1127 BC	50-60		6.9			59.0	25.0	16.0	SL.		
122 1127 CK	60-70		7.7	0.38	16.8	53.0	31.0	16.0	SL.		

		TOT N %	CN RATI	CEC mg/100	EXC CA mg/100	EXC MG mg/100	EXC K mg/100	EXC NA mg/100	% FIBRE unrub	% FIBRE rubbed
112 1099 OM	120-210	1.11	8.74	63.7	23.5	5.0	0.1	0.3	84	72
113 1103 AE	0-6	0.04	16.3	5.5	4.2	0.7	0.1	0.0		
114 1103 BNT	12-40			20.1	12.2	5.5	0.2	0.1		
115 1103 BC	40-75			9.0	13.4	6.6	0.2	0.2		
116 1103 CK	90-110			16.8	28.5	5.3	0.2	0.2		
117 1112 AE	0-5	0.04	25.0	4.4	2.0	0.2	0.1	0.0		
118 1112 BM	10-50			1.7	0.4	0.0	0.1	0.0		
119 1112 C	60-100			2.4	0.4	0.0	0.1	0.0		
120 1127 BM	0-30			7.7	3.1	0.6	0.2	0.0		
121 1127 BC	50-60			9.1	11.5	0.6	0.2	0.0		
122 1127 CK	60-70			11.1	31.4	0.7	0.1	0.1		

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		ASH	PH	EC mS/cm	%CACO3 equiv.	SAND %	SILT %	CLAY %	TEXTURE	ORG MAT %	TOT C %
123 1141 AE	0-8		4.5			62.0	32.0	6.0	SL.	2.9	1.66
124 1141 BM	10-30		4.9			62.0	22.0	16.0	SL.		
125 1141 BC	40-60		4.8			83.0	12.0	5.0	LS.		
126 1141 CK	60-100		4.9			82.0	13.0	5.0	LS.		
127 1153 AE	0-10		7.2	0.29						1.8	1.02
128 1153 BM	15-50		6.7								
129 1171 BM	0-5		6.9								
130 1171 BM	10-30		7.2	0.25							
131 1171 BC	50-75		7.0								
132 1178 OM (OF)	0-40	4.21	3.5							83.8	48.7
133 1178 OM2	40-75	6.24	4.1							80.0	46.5

		TOT N %	CN RATI	CEC mg/100	EXC CA mg/100	EXC MG mg/100	EXC K mg/100	EXC NA mg/100	% FIBRE unrub	% FIBRE rubbed
123 1141 AE	0-8	0.07	23.7	5.4	1.5	0.4	0.2	0.0		
124 1141 BM	10-30			9.1	1.5	0.5	0.3	0.0		
125 1141 BC	40-60			3.5	0.2	0.0	0.1	0.0		
126 1141 CK	60-100			3.3	0.2	0.0	0.1	0.0		
127 1153 AE	0-10	0.06	17.0							
128 1153 BM	15-50									
129 1171 BM	0-5									
130 1171 BM	10-30									
131 1171 BC	50-75									
132 1178 OM (OF)	0-40	0.74	65.8	57.4	9.1	3.8	0.3	0.2	82	72
133 1178 OM2	40-75	0.72	64.6	61.1	16.6	6.2	0.1	0.4	84	74

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		ASH	PH	EC mS/cm	%CACO3 equiv.	SAND %	SILT %	CLAY %	TEXTURE	ORG MAT %	TOT C %
134 1178 CG	75-110		6.6			35.0	43.0	22.0	L.		
135 1192 OH	5-20		6.0							80.7	46.9
136 1192 CG	30-45		5.9			35.0	43.0	22.0	L.		
137 1192 CG	45-65		6.0			41.0	23.0	36.0	CL.		
138 1192 CG	65-100		6.7			27.0	25.0	48.0	C.		
139 1205 OH	0-30	10.7	7.4	1.39						77.9	45.3
140 1205 OH	30-75	43.1	6.3							53.1	30.9
141 1205 CG	75-90		7.3	0.28		25.0	31.0	44.0	C.		
142 1226 LF	4-0		4.3							46.8	27.2
143 1226 AE	0-10		4.2			45.0	39.0	16.0	L.	1.8	1.07
144 1226 BT	50-75		5.0			29.0	20.0	51.0	C.		

		TOT N %	CN RATI	CEC mg/100	EXC CA mg/100	EXC MG mg/100	EXC K mg/100	EXC NA mg/100	% FIBRE unrub	% FIBRE rubbed
134 1178 CG	75-110			3.9	6.2	2.8	0.1	0.1		
135 1192 OH	5-20			70.0	37.3	14.0	0.5	0.5		
136 1192 CG	30-45			7.9	4.3	2.1	0.1	0.1		
137 1192 CG	45-65			13.3	7.7	4.3	0.2	0.2		
138 1192 CG	65-100			17.9	11.6	7.1	0.2	0.3		
139 1205 OH	0-30	1.75	25.9	57.1	37.6	12.1	0.9	1.2	52	28
140 1205 OH	30-75	1.56	19.8	128	114	20.3	0.1	1.9	42	10
141 1205 CG	75-90			19.1	15.8	4.5	0.2	0.8		
142 1226 LF	4-0	0.76	35.8	33.9	8.8	2.2	0.6	0.2		
143 1226 AE	0-10	0.05	21.4	9.9	0.9	0.8	0.1	0.0		
144 1226 BT	50-75			16.2	9.3	4.3	0.3	0.1		

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		ASH	PH	EC mS/cm	%CACO3 equiv.	SAND %	SILT %	CLAY %	TEXTURE	ORG MAT %	TOT C %
145 1226 CK1	50-75		5.5			23.0	26.0	51.0	C.		
146 1226 CK2	90-110		8.0	0.25	5.91	39.0	37.0	24.0	L.		
147 1238 AE	0-15		6.8							1.3	0.78
148 1238 BT	30-40		7.6	0.49	0.91						
149 1238 BC	50-75		7.8	0.46	1.36						
150 1238 BC	80-100		8.2	0.52	5.91						

		TOT N %	CN RATI	CEC mg/100	EXC CA mg/100	EXC MG mg/100	EXC K mg/100	EXC NA mg/100	% FIBRE unrub	% FIBRE rubbed
145 1226 CK1	50-75			17.3	11.5	4.1	0.2	0.1		
146 1226 CK2	90-110			7.5	30.1	2.3	0.1	0.2		
147 1238 AE	0-15	0.05	15.6							
148 1238 BT	30-40									
149 1238 BC	50-75									
150 1238 BC	80-100									

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		ASH	PH	EC mS/cm	%CACO3 equiv.	SAND %	SILT %	CLAY %	TEXTURE	ORG MAT %	TOT C %
101 1248 AEGJ	0-8		5.9			17.0	61.0	22.0	Sil.	0.7	0.42
102 1248 BTGJ	15-25		6.5			18.0	23.0	59.0	C.		
103 1248 BC	50-75		7.8	1.06	1.82	21.0	28.0	51.0	C.		
104 1248 BC	80-100		8.1	1.40	2.27	20.0	22.0	58.0	C.		
105 1253 LF (F)	10-0		5.0							38.5	22.4
106 1253 AH	0-8		5.1							13.0	7.57
107 1253 AE	8-21		5.3							2.0	1.16
108 1253 BT	21-30		4.9								
109 1253 BC	60-75		7.4	1.21							
110 1267 LFH	4-0		6.1							13.6	7.91
111 1267 BM	10-17		5.8								

		TOT N %	CN RATI	CEC meq/100	EXC CA meq/100	EXC MG meq/100	EXC K meq/100	EXC NA meq/100	% FIBRE unrub	% FIBRE rubbed
101 1248 AEGJ	0-8	0.04	10.5	4.2	1.4	1.4	0.1	0.2		
102 1248 BTGJ	15-25			23.0	8.1	12.9	0.4	1.3		
103 1248 BC	50-75			18.5	7.3	12.5	0.4	1.8		
104 1248 BC	80-100			21.5	11.4	13.5	0.5	3.0		
105 1253 LF (F)	10-0	1.08	20.7							
106 1253 AH	0-8	0.62	12.2							
107 1253 AE	8-21	0.08	14.5							
108 1253 BT	21-30									
109 1253 BC	60-75									
110 1267 LFH	4-0									
111 1267 BM	10-17									

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		ASH	PH	EC mS/cm	%CACO3 equiv.	SAND %	SILT %	CLAY %	TEXTURE	ORG MAT %	TOT C %
112 1267 BC	25-32		6.0								
113 1271 BM	0-15		6.4								
114 1271 BC	35-45		6.3								
115 1278 OM1	10-60	15.9	5.8							71.2	41.4
116 1278 OM2	60-100	13.7	5.7							76.5	44.5
117 1278 CG	100-120		4.8			45.0	33.0	22.0	L.		
118 1290 OM	10-30	13.1	6.1							78.8	45.8
119 1290 OM	30-60	14.6	6.1							73.3	42.6
120 1290 CG	70-100		6.2			43.0	24.0	33.0	CL.		
121 1298 OM	0-25	5.83	3.4							86.3	50.2
122 1298 OM2	40-60	4.88	3.5							85.5	49.7

		TOT N %	CN RATI	CEC meq/100	EXC CA meq/100	EXC MG meq/100	EXC K meq/100	EXC NA meq/100	% FIBRE unrub	% FIBRE rubbed
112 1267 BC	25-32									
113 1271 BM	0-15									
114 1271 BC	35-45									
115 1278 OM1	10-60	1.43	29.0	45.1	24.5	14.7	0.2	2.0	90	50
116 1278 OM2	60-100	1.64	27.1	66.3	33.8	14.8	0.1	1.7	66	30
117 1278 CG	100-120			10.4	4.7	2.0	0.1	0.3		
118 1290 OM	10-30	1.58	29.0	71.7	48.0	20.5	0.3	0.6	80	50
119 1290 OM	30-60	1.61	26.5	77.7	55.5	21.3	0.2	0.7	74	38
120 1290 CG	70-100			15.7	10.0	4.9	0.1	0.2		
121 1298 OM	0-25	0.98	51.2						78	62
122 1298 OM2	40-60	0.96	51.8						74	64

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		ASH	PH	EC mS/cm	%CACO3 equiv.	SAND %	SILT %	CLAY %	TEXTURE	ORG MAT %	TOT C %
123 1305 OM	0-25	12.8	5.7							77.1	44.8
124 1305 OM	25-40	12.7	5.2							78.6	45.7
125 1305 CG	45-75		6.1			33.0	31.0	36.0	CL.		
126 1317 AE	0-10		6.0			43.0	48.0	9.0	L.	1.3	0.74
127 1317 AB	20-40		4.7			19.0	16.0	65.0	HC.		
128 1317 BT	50-75		4.7			23.0	16.0	61.0	HC.		
129 1327 AEGJ	0-10		5.5			22.0	55.0	23.0	SiL.	4.3	2.49
130 1327 BTGJ	25-40		6.6			21.0	38.0	41.0	C.		
131 1327 CK	50-75		8.1	0.81	6.82	13.0	35.0	52.0	C.		
132 1327 CK	80-100		8.3	0.94	7.28	10.0	35.0	55.0	C.		
133 1341 OM	0-25	11.7	6.4							85.1	49.5

		TOT N %	CN RATI	CEC mg/100	EXC CA mg/100	EXC MG mg/100	EXC K mg/100	EXC NA mg/100	% FIBRE unrub	% FIBRE rubbed
123 1305 OM	0-25	1.27	35.3	61.4	21.4	21.6	0.1	0.6	72	62
124 1305 OM	25-40	1.10	41.5	68.0	29.6	19.0	0.1	0.7	74	50
125 1305 CG	45-75			17.5	10.9	5.7	0.2	0.2		
126 1317 AE	0-10	0.12	6.17	5.2	2.2	0.1	0.1	0.0		
127 1317 AB	20-40			23.1	8.5	4.1	0.3	0.1		
128 1317 BT	50-75			22.6	8.8	4.3	0.3	0.2		
129 1327 AEGJ	0-10	0.20	12.4	8.8	2.4	1.5	0.1	0.2		
130 1327 BTGJ	25-40			18.5	8.6	6.2	0.2	1.7		
131 1327 CK	50-75			17.3	33.3	6.7	0.2	3.4		
132 1327 CK	80-100			17.3	26.3	6.7	0.3	3.6		
133 1341 OM	0-25	1.69	29.3	74.0	50.0	18.5	0.5	0.7	82	48

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		ASH	PH	EC mS/cm	%CACO3 equiv.	SAND %	SILT %	CLAY %	TEXTURE	ORG MAT %	TOT C %
134 1341 OM	25-40	21.1	6.7							69.5	40.4
135 1341 CG1	50-75		7.2	0.26		22.0	42.0	36.0	CL.		
136 1341 CG2	110-130		7.9	0.38	6.37	22.0	32.0	46.0	C.		
137 1368 OF	0-40	2.60	3.9							81.7	47.5
138 1368 OFZ	45-60	4.68	4.2							83.8	48.7
139 1368 OM	80-100	7.30	5.3							85.1	49.5
140 1378 OF	0-25	3.45	4.1							82.4	47.9
141 1378 OF	25-75	3.35	4.1							85.1	49.5
142 1378 OM (OF)	75-120	7.93	5.0							87.7	51.0
143 1388 OF	0-20	6.36	4.3							83.9	48.8
144 1388 OF	25-75	6.88	5.0							80.5	46.8

		TOT N %	CN RATI	CEC mg/100	EXC CA mg/100	EXC MG mg/100	EXC K mg/100	EXC NA mg/100	% FIBRE unrub	% FIBRE rubbed
134 1341 OM	25-40	1.45	27.9	74.0	49.5	21.2	0.1	1.1	76	44
135 1341 CG1	50-75			10.5	8.5	5.0	0.2	0.6		
136 1341 CG2	110-130			15.8	31.1	5.2	0.2	0.9		
137 1368 OF	0-40	0.84	56.5	38.0	6.9	3.1	0.2	0.2	92	86
138 1368 OFZ	45-60	1.54	31.6	64.6	17.6	6.7	0.1	0.3	90	70
139 1368 OM	80-100	1.03	48.1	69.1	30.9	8.6	0.1	0.4	88	60
140 1378 OF	0-25	0.64	74.8	40.3	8.3	4.0	0.4	0.2	94	82
141 1378 OF	25-75	0.86	57.6	42.3	9.3	4.5	0.3	0.1	96	78
142 1378 OM (OF)	75-120	1.13	45.1	64.0	30.5	5.8	0.1	0.4	76	34
143 1388 OF	0-20	0.84	58.1	45.7	12.8	4.8	0.5	0.2	90	70
144 1388 OF	25-75	0.82	57.1	59.1	27.5	8.0	0.1	0.3	90	76

ANALYST

NORWEST LABS

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PEDOCAN LAND LTD
4211-95 STREET
EDMONTON
ALBERTA
T6E 5R6

LEASE 22

SYNCRUDE

		ASH	PH	EC mS/cm	%CACO3 equiv.	SAND %	SILT %	CLAY %	TEXTURE	ORG MAT %	TOT C %
145 1388 OF	75-110	11.0	5.5							79.5	46.2
146 1409 OM	0-25	13.3	6.0							79.1	46.0
147 1409 OM	25-60	13.6	5.7							81.0	47.1
148 1409 OMZ	60-85	13.9	5.5							78.8	45.8
149 1409 CG	85-100		5.3			40.0	23.0	37.0	CL.		
150 1424 AE	0-10		5.9							0.9	0.50

		TOT N %	CN RATI	CEC mg/100	EXC CA mg/100	EXC MG mg/100	EXC K mg/100	EXC NA mg/100	% FIBRE unrub	% FIBRE rubbed
145 1388 OF	75-110	0.97	47.6	65.1	51.0	6.7	0.1	0.4	80	68
146 1409 OM	0-25	1.40	32.9	64.3	49.3	12.4	0.1	1.2	78	44
147 1409 OM	25-60	1.28	36.8	72.9	58.8	12.8	0.1	1.2	76	50
148 1409 OMZ	60-85	1.50	30.5	70.3	37.0	10.5	0.1	0.8	68	40
149 1409 CG	85-100			14.5	8.2	3.8	0.2	0.2		
150 1424 AE	0-10	0.04	12.5							

ANALYST

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ALBERTA
T6E 5R6

LEASE 22

SYNCRUDE

		PH	EC mS/cm	%CACO3 equiv.	SAND %	SILT %	CLAY %	TEXTURE	ORG MAT %	TOT C %	TOT N %
101 1424 BT	15-30	6.6									
102 1424 IIBC	45-60	7.6	0.32	2.27							
103 1424 CK	60-90	7.9	0.31	7.28							
104 1424 CK	90-120	8.0	0.33								
105 1439 AEGJ	0-10	6.6							1.0	0.59	0.03
106 1439 ABGJ	12-20	7.0									
107 1439 BTGJ	20-40	7.2	3.48								
108 1439 CK2	75-100	7.9	3.10	6.37							
109 1461 AE	0-8	6.0			54.0	37.0	9.0	SL.	1.3	0.73	0.04
110 1461 BT	15-40	4.8			26.0	23.0	51.0	C.			
111 1461 BC	40-75	5.0			20.0	17.0	63.0	HC.			

		CN RATI	CEC mg/100	EXC CA mg/100	EXC MG mg/100	EXC K mg/100	EXC NA mg/100
101 1424 BT	15-30						
102 1424 IIBC	45-60						
103 1424 CK	60-90						
104 1424 CK	90-120						
105 1439 AEGJ	0-10	19.7					
106 1439 ABGJ	12-20						
107 1439 BTGJ	20-40						
108 1439 CK2	75-100						
109 1461 AE	0-8	18.3	4.8	2.6	0.7	0.1	0.0
110 1461 BT	15-40		15.3	7.1	4.7	0.2	0.1
111 1461 BC	40-75		23.1	10.8	7.2	0.3	0.2

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SYNCRUDE

			PH	EC mS/cm	%CACO3 equiv.	SAND %	SILT %	CLAY %	TEXTURE	ORG MAT %	TOT C %	TOT N %
112	1461 IIBC	75-90	7.5	0.30	3.18	31.0	26.0	43.0	C.			
113	1479 LFH (H)	6-0	5.6							28.6	16.6	
114	1479 AEGJ	0-7	5.4			34.0	33.0	13.0	SiL.	1.6	0.91	0.05
115	1479 BNTGJ	20-30	5.1			19.0	29.0	52.0	C.			
116	1479 BCGJ	40-70	7.0			20.0	29.0	51.0	C.			
117	1479 Ck	70-110	7.9	1.00	7.28	22.0	33.0	45.0	C.			
118	1480 LFH	6-0	5.1							72.6	42.2	
119	1480 AE	0-10	4.7							1.0	0.56	0.04
120	1480 BM	12-19	5.0									
121	1430	0-50	5.7									
122	1430	50-70	5.7									

			CN RATI	CEC meq/100	EXC CA meq/100	EXC MG meq/100	EXC K meq/100	EXC NA meq/100
112	1461 IIBC	75-90		14.9	16.8	6.0	0.2	0.2
113	1479 LFH (H)	6-0		27.3	13.6	5.4	0.6	0.1
114	1479 AEGJ	0-7	18.2	7.2	3.2	1.9	0.2	0.0
115	1479 BNTGJ	20-30		23.3	8.2	12.0	0.5	0.2
116	1479 BCGJ	40-70		22.9	10.6	12.7	0.3	0.5
117	1479 Ck	70-110		13.5	28.1	9.8	0.2	1.1
118	1480 LFH	6-0						
119	1480 AE	0-10	14.0					
120	1480 BM	12-19						
121	1430	0-50						
122	1430	50-70						

ANALYST

MAPS
NOT
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CARTES
OMISES